THE

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ELECTRICAL REVIEW.

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CONTRACTS FOR PUBLIC WORKS.

As representing an industry which has been, and still is being, hit hard by the municipal trader, we always take a deep interest in the proceedings of those who have the disposal of the ratepayers' money. The recent disclosure of the conduct of the Poplar Guardians, in constantly accepting the *highest* tender for food to be supplied to the workhouse, draws attention to the question—have Guardians the right to squander the money of those who have so put their trust in them?

Inasmuch as the principles which regulate the making of contracts with Guardians are of general application, and may be held applicable to other cases in which local authorities enter into contracts for electric lighting, &c., the following observations may be deemed pertinent.

It is provided by Sec. 49 of the Poor Law Amendment Act, 1834, that all contracts for the maintenance, clothing, lodging, employment, or relief of the poor which shall not be made and entered into in conformity with the rules, orders, or regulations of the Poor Law Commissioners, shall be null and void if the Commissioners shall so direct. Art. 45 of the General Consolidated Order, 1847, provides that the Guardians shall require tenders to be made in some sealed paper for the supply of all provisions, fuel, clothing, furniture, or other goods or materials, the consumption of which may be estimated, one month with another, to exceed £10 per month, and of all provisions, fuel, clothing, furniture, or other goods or materials, the cost of which may be reasonably estimated to exceed £50 in a single sum, and shall purchase the same upon contracts to be entered into after the receipt of such tenders.

Mr. Glen, in his "Poor Law Orders" (p. 237), points out that:—"The Guardians by these Articles are not bound to accept the lowest tenders given in, nor in the event of there being only one person tendering for the supply of a particular kind of goods, are they bound to accept his tender. Moreover, they are not bound to accept any tender that may be sent in if they are not satisfied that it would be advantageous to the Union to do so, but may advertise again." If this be an accurate statement of the law—and we have no reason to doubt its accuracy—the provisions which are made for advertisement for tenders are, to say the least, somewhat superfluous. It is provided by Art. 47 that notice of the nature and conditions of the contract to be entered into of the estimated amount of the articles required, of the last day on which tenders will be received, and the day on which tenders shall be opened, shall be given in some newspaper circulating in the Union, not less than 10 days previous to the last day on which such tenders are to be received.

"The purpose of inserting Union advertisements in newspapers," writes the Poor Law Board in an official circular, "is to obtain the utmost publicity for them, and the Commissioners have stated that they consider that the advertise-

ments ought to be inserted in the newspaper which circulates the most widely among the class of persons who are likely to make the desired tenders, or to whom the advertisements may have in other respects addressed, and that the choice of a newspaper ought to be determined by these considerations, without any reference to the opinions, either on the administration of the Poor Law, or on any other subject which may have been expressed in the newspapers."

If the law is as above stated, it is difficult to point to any direct remedy to which ratepayers may have recourse. There are, however, one or two passages in the Poor Law Orders which are well worthy of attention. It is provided by Art. 218 that no clerk, relieving officer, master, or other officer appointed to or holding any office, shall directly, or indirectly, receive, or bargain to receive, any gratuity, percentage, or allowance of any kind with reference to any contract with the Guardians, or in respect of any payment made, or to be made, for goods supplied or work executed according to the order of such Guardians, or on their behalf. It is also worthy of notice that by the Local Government Act, 1894, any person who is concerned in any bargain or contract entered into with the council or board, or participates in the profit of any such bargain or contract, or of any work done under the authority of the council or board. If, therefore, there is any reason to believe that any officer of a poor law union, or any guardian, is interested in any contract, his conduct may be called in question. The only other provision by which the law enables ratepayers to protect themselves, is that which enables them to attend at and raise objections upon the audit of the union accounts. But this is at best but a poor measure of relief, seeing that the function of the auditor is merely to satisfy himself that the payments which have been made are within the law.

We have not been able to say much to encourage the hope that ratepayers have any satisfactory remedy at law. The only step which can be taken is to unseat the guardians who are guilty of extravagance. "But how!" cries the middle-class ratepayer, "are they to be unseated? We are hopelessly out-numbered." It is true that in the eye of the law "There is no wrong without a remedy." In the circumstances which we have been considering, however, the remedy would appear to be hopelessly inadequate.

Electric Lighting by Wind Power.

The neglect of this source of power so far as electric lighting is concerned, is attributable to a lack of special knowledge in those districts where the wind can be more or less depended on. Many places in this country have wind power available almost continuously (exposed coast), and although what are consequently called "sheltered" spots do not get so much ground wind, it would generally be possible to find even there an elevation at which the air was more disturbed. Calms of three days to a week have to be reckoned with, but these are more likely to occur in summer.

No one would advocate the installation of a wind-power lighting plant where current could be obtained from a supply company at a reasonable rate, or in a very sheltered situation, but districts must be known to everyone where a calm day is quite the exception. It is here that one would expect the wind to be utilised in a variety of ways, and it is curious that the lead given years ago, when the old tower mills to be found in such situations were built, has not been more frequently followed. Since the introduction of the "disk" or "American" windmill, the use of wind power for pumping has been fairly well recognised: but one does not find it largely used for electric lighting. In Germany we know of several installations, and in this country one at least has been noted and described. At this latter the storage battery has a capacity of 490 A.H., and the number of lamps is equal to 100 of 16-C.P. This is a very representative small plant, and shows that the project may be practically carried out. It is probably doubt upon the latter point which has hitherto kept others from taking advantage of one of the cheapest forms of power.

British Engineering Abroad.

It is becoming more and more certain every year that if our engineering manufacturers want to find sufficient work to keep themselves fully employed in the future they will have to be more strenuous in their business-getting efforts abroad. This necessity has long been recognised by a number of the leading manufacturing and contracting firms and companies in the electrical department, who find greater chances of doing profitable work abroad, now that things are so cut at home, and also seeing that there is not the same room for lighting and tramway development that there was, say, 10 years ago, when so many new works were untouched. One of the best-known engineering companies in the Manchester district—we refer to Messrs. Mather and Platt, Ltd.—has been very successful from a dividend-paying point of view for a good many years, but how far electrical machinery contracts have helped toward that success, it is impossible to say, for the company has a world-wide reputation for other engineering lines as well. From the beginning, as Sir William Mather told his shareholders last week, the company's policy had been to extend as far as possible the field of work in countries other than Great Britain, and it is gratifying to notice that during the past year their foreign trade has increased everywhere save in Russia—where, of course, the conditions have been quite exceptionally adverse to trading operations. Sir William has great hopes regarding the future of Russia from an industrial development point of view, but only under a new *régime*; with these observations we must all agree, though the development is hardly likely to take place either this year or next. Messrs. Mather & Platt have found Colonial and foreign orders to form a large portion of their turnover, and as the foreign branch is the most remunerative, it is intended to encourage it very vigorously. Such observations as these should interest other manufacturers, and lead them to turn greater attention in a similar direction instead of engaging in cut-throat competition at home. The Electrical Review has endeavoured to render them some assistance recently by the publication of a series of informing articles on "The Neutral Markets of the World." Other utterances made by Sir William are also worth recording. He pointed out that in spinning and weaving machinery there had been a boom, but the prospects, so far as motive power and electrical work of all kinds were concerned, were not hopeful. Internal competition had become extremely keen, and only a small margin of profit could be obtained by the best engineers. They had come to the conclusion that engineers must be very active outside their own country in order to maintain a position in the future and to provide for the shareholders a moderate and fair return on their capital. It was, therefore, the foreign connections they must try to cultivate. In England low prices were likely to obtain for some time to come, and it behoved everybody engaged in the industry to husband his resources.

ACCURATE SPEED, FREQUENCY AND ACCELERATION MEASUREMENTS.

By CHARLES V. DRYSDALE, D.Sc.

Among the various quantities to be measured in engineering testing, that of speed is one of the most important, and one of the most difficult to obtain with accuracy. Wherever comparisons are made of the electrical and mechanical performances of a generator or motor, it is necessary to measure the speed to the same degree of accuracy as the P.D. or current; while in alternate current work, the accurate measurement of frequency is of importance. Again, acceleration tests are frequently required in traction work and in the determination of losses or starting torques of machines.

Notwithstanding the fact that numerous methods and instruments are available for speed measurements, there are few which combine the various features which are desirable in such tests. The speed indicator or device should be accurate, prompt and convenient in operation, and should have no appreciable friction or power absorption.

The methods in general use may be briefly classified as follows:—

Counting Methods.—(*a*) Counter and watch.
(*b*) Chronograph and electric contact.
Mechanical Methods.—(*c*) Centrifugal force of governor.
(*d*) Centrifugal force of liquid.
(*e*) Mechanical resonance.
Electrical Methods.—(*f*) Faraday disk and galvanometer.
(*g*) Permanent magnet, D.C. generator and voltmeter.
(*h*) Induction generator and hot-wire voltmeter.
(*i*) Resonance of reed with electro-magnet.
(*j*) Torque produced by eddy currents.

Taking these in order, the counting methods, though frequently used, cannot be regarded as satisfactory. They do not show rapid variations in the speed, and are very inconvenient. They form, however, an absolute check on any other method when uniform speed can be obtained. Of the mechanical methods, probably by far the best is the method of resonance, carried out to such great perfection by Herr Frahms,* in which a number of tuned reeds are either attached to a support mechanically connected to the rotating shaft, or are actuated by a magnet receiving pulsating currents from a small inductor generator or a contact on the shaft. The same arrangement has been made by Messrs. Hartmann & Kemf, who, in fact, were the first to employ this method for frequency measurement, the difference between their instruments and those of Herr Frahms being that in the former the magnet acts directly on the tuned reeds, while in the latter it acts upon their support and causes them to vibrate mechanically. Provided that the reeds are sufficiently numerous and perfectly tuned, this apparatus is almost as perfect as can be desired, and can certainly be read to an accuracy of one or two tenths per cent. Some mechanical power is, of course, taken by it, but of relatively small amount, and where the instrument is simply attached to the machine case it is negligible.

The centrifugal method in the ordinary form is, in the writer's experience, satisfactory at first, but is apt to deteriorate from wear after much use, and is liable to hunt. As to Dr. Fleming's method,† this is, doubtless, very accurate and quick in response, but although the writer has not used it, it appears probable that in order to get a liquid-tight gland an appreciable amount of friction must be introduced. Where, however, as is frequently the case, this friction is unimportant, this device is specially convenient, as it can be read from a distance and is unaffected by temperature.

* Frahms, D.R.P. No. 134,712.
† Prof. J. A. Fleming, "Tachometry," *Cassier's Magazine*, November, 1901, p. 37.

Coming to electrical methods, the proportionality of E.M.F. to speed in a generator has always seemed to point to a convenient method of measurement. The writer has devised and used in the laboratories of the Northampton Institute for some years a Faraday disk indicator, in which the E.M.F. produced by a disk rotating in the field of a permanent magnet is measured by a moving-coil galvanometer. The arrangement is depicted in fig. 1, which shows that two circular wrought-iron cheeks are screwed to the poles of a horse-shoe permanent magnet. In the small space between these cheeks the disk rotates, and contact is made to the edge of this disk by thin springs. The disk is enclosed in a red fibre case, and a few drops of mercury are put in this case to ensure good contact. The smallness of the E.M.F. induced, however, has made the contact question a very difficult one, and although it has been successfully overcome, the arrangement is somewhat too delicate for general use. It has, however, the advantage of simplicity and of extremely small friction.

In a more recent form of this indicator Mr. Jolley has employed a highly saturated electro-magnet and a single-pivot galvanometer with excellent results.

The inductor generator with hot wire voltmeter as indicator has been used considerably of late, especially for automobiles. It is very simple and convenient, and probably not very easily deranged. Hot wire voltmeters at their best, however, appear to be somewhat unreliable, and although this arrangement will probably be considerably used, it may be doubted whether it will ever be reliable within 1 or 2 per cent. At first sight it would appear that a small D.C. machine with permanent magnet field, as is made by the A.E.G., would be satisfactory, as a fairly high voltage can be easily obtained, which may be measured on a voltmeter of the permanent magnet or other type. In the writer's experience, however, this has not been the case, and he is inclined to attribute the variations to the commutator as well as to gradual weakening of the magnet. Nearly all these electrical methods also absorb an appreciable amount of power.

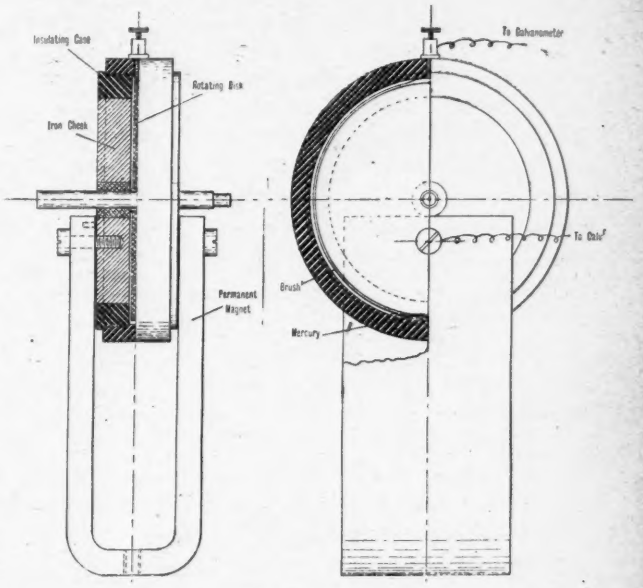


Fig. 1.—Faraday Speed Indicator.

Turning to the eddy current tachometer of many well-known types, this is, of course, simple and fairly effective. Its principal drawback is its somewhat large temperature error. Since the torque varies as the specific resistance of the material, it follows that with most pure metals the reading will vary nearly $\frac{1}{2}$ per cent. per degree Centigrade. In common, also, with all the previous electrical methods, variations in the permanent magnet affect its readings. As the strength of these magnets decreases about ·2 per cent. per degree, and the torque varies as the square of the induction, we get a total variation of about ·8 per cent. to 1 per cent. per degree C.

Of all the methods above described, the writer is inclined to think that the resonance method of Hartmann & Kemf, Campbell, and Frahms, is at once the best, both for speed and frequency measurements. The difficulty in such instruments is simply that of checking the accuracy of the adjustment of the reeds, as it is evident that each one must be independently tested. In other respects, the instruments are very sensitive, convenient and free from changes. For accurate work, however, there can be no doubt that there is still room for a more satisfactory method of speed measurement. Especially is this the case when rapid changes of speed are to be observed. Hardly a single one of the instruments above described is sufficiently prompt in its action to take acceleration curves from motors when started or stopped, and in this case especially, it is of importance that no friction should be introduced by the speed indicator.

Tuning Fork or Stroboscopic Method.—After experimenting with most of the devices mentioned, the writer has discarded them all for accurate testing work, and has fallen back upon the already known, but little used, device of a tuning fork provided with shutters and slits on its prongs, as in fig. 2. Such a tuning fork when vibrating enables

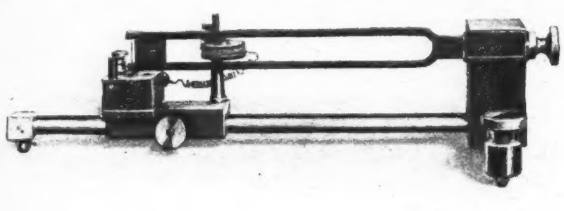


Fig. 2.—Electrically-driven Tuning Fork with Slits.

light to pass through the slits twice in each period, and as the rate of vibration of the fork is an almost perfectly constant quantity the number of flashes per second is always fixed and known with great precision. If then a number of dots equally spaced are marked round the periphery of a disk or cylinder attached to the rotating shaft, these dots will appear stationary when viewed through the slits of the vibrating fork, if the time taken for one dot to rotate into the position of any other is equal to the time between the flashes. It immediately follows that if n is the frequency of the fork in periods per second, and N is the number of dots in the periphery, the dots will appear stationary when the speed of the shaft in revolutions per minute is $a\,\frac{120\,n}{N}$ where a is a multiplier. If a is 1, 2, 3, &c., the row of dots will appear single, if it is $\frac{1}{2}$, $1\frac{1}{2}$, $2\frac{1}{2}$, $3\frac{1}{2}$, &c., double, and if a is $\frac{1}{3}$, $\frac{2}{3}$, $1\frac{1}{3}$, $1\frac{2}{3}$, $2\frac{1}{3}$, &c., triple. As an illustration, if a 50-period fork is used $120\,n = 6{,}000$ flashes per minute. If a ring of 6 dots is used it will appear stationary and single for speeds of 1,000, 2,000, 3,000, &c., double for 500, 1,500, 2,500, &c., and triple for 333·3, 666·7, 1,333, 1,667, &c. By having two or three rows of different numbers of dots a large range of speeds can be found for which one or other row will appear stationary and either single, double, or triple. The drawback to the use of dots in these measurements is that they are extremely confusing, and it is difficult to recognise the particular number desired. If, however, instead of a series of dots a definite easily recognisable geometrical design is employed no difficulty is experienced. The writer has employed a diagram of the form shown in fig. 3, in which a square is surrounded by a pentagon and a hexagon. This diagram is very convenient and gives a sufficient range of speeds for any calibration or acceleration tests. The square appears single for speeds of 1,500 and 3,000, double for 750 and 2,250, and triple for 500, 1,000, 2,000 and 2,500 r.p.m. A single pentagon is seen for speeds of 1,200, 2,400 and 3,600, double for 600, 1,800 and 3,000, and triple for 400, 800, 1,600, 2,000, 2,800, and 3,200 revs. The hexagon is single for 1,000, 2,000 and 3,000 revs., double for 500, 1,500 and 2,500, and triple for 333·3, 666·7, 1,333, 1,667, 2,333 and 2,667 revs. If it be desired to test each 100 revs., a 30-pointed figure may be added. This appears single for any even, and double for any odd number of hundreds of revolutions, while the other figures indicate what the particular speed is.

For the calibration of speed indicators such a device is probably the most perfect and convenient that can be employed. As in this case the speed is maintained steady during the test, there is no need for an electrically driven tuning fork. All that is required is a small motor, fig. 4,

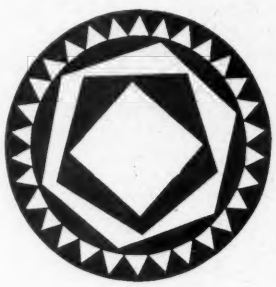


Fig. 3.

to which the speed indicator may be attached, and the other end of which bears a disk with the design on it. A tuning fork with slits, fixed in front of this disk is set in vibration, and the speed of the motor regulated until any

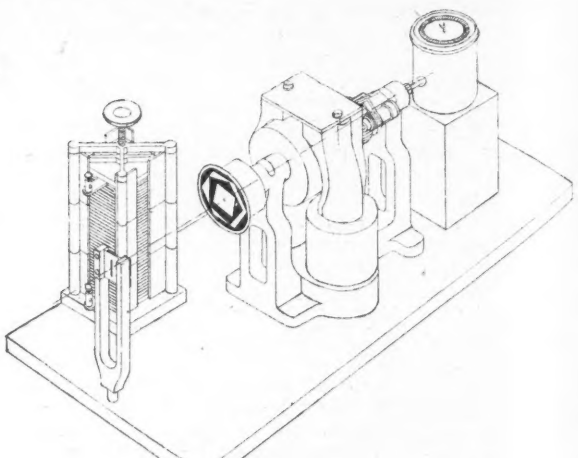


Fig. 4.—Calibrating Device.

desired figure is stationary. It is possible in this way to regulate the speed to an accuracy of 1 part in 10,000, as was done in the Lorenz apparatus for the determination of the ohm, while all measurements are made with the same accuracy in terms of the same standard. This standard only varies

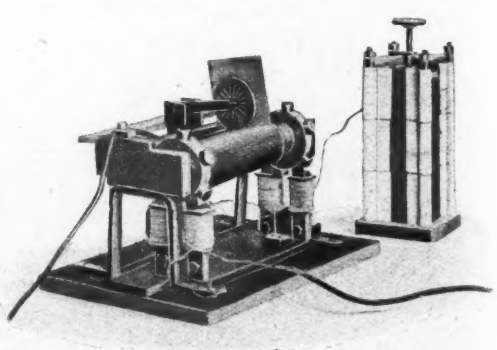


Fig. 5.—Roller Stroboscope.

with temperature about ·01 per cent. per degree C., according to the measurements of König and of Stone and McLeod.

It may be desired, however, to test the speed of a motor at any intermediate value. For this purpose there are two alternatives. A conical roller may be fixed to the motor on which rolls a disk having the design on it. Whatever may

be the speed, one or other of the figures on the rolling disk may be made to appear stationary when viewed through the shutters of the vibrating fork by traversing the disk along the roller, thereby gearing its speed up or down by any desired ratio to that of the motor, and the speed read off on a direct-reading scale which may be calculated out once for all. A better way which the writer proposes to adopt is to put an electro-magnet in series with the fork which runs a conical roller in synchronism with it, fig. 5. By looking at a design on the motor shaft through slits in a disk rolling on the cone the speed can be read off on a uniformly divided scale to an accuracy within ·1 per cent. and without attaching anything but the design to the motor shaft. The writer has had the design in fig. 3 printed on cards that may be immediately fixed to any shaft.

(*To be concluded.*)

HOW ELASTIC STREAM LINES ARE POLARISED.

By W. H. BOOTH.

According to the kinetic theory of gases, they consist of an infinity of molecules endowed with automobile powers by virtue of the heat that is in them. Such molecules move at a certain mean velocity along straight paths, the length of which is limited only by the number of molecules occupying a given space. All the phenomena such as pressure, &c., can be explained on the kinetic assumption. We may assume that the molecules in any mass of gas, such as would be enclosed, say, in a box of 1-ft. cube, are divided into three equal numerical divisions, of which one division moves up and down vertically, a second moves horizontally to and fro, and the third moves horizontally, but in a path normal to the second path. Were the molecules few in number, it would be possible so to arrange them that they would in no case collide. In an actual gas, even when of extreme tenuity, there are so many molecules present in a given space that collisions are innumerable, and there is no regularity of movement, and the free path is very short. But the average of the innumerable produces a resultant pressure so regular that human observation cannot detect any difference on the four vertical planes of a cube, while on

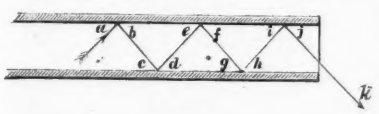


Fig. 1.

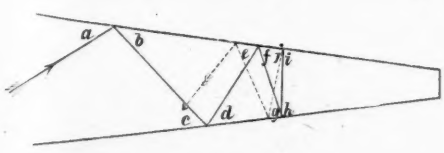


Fig. 2.

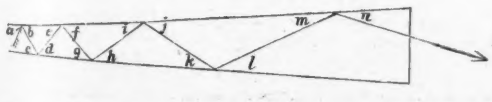


Fig. 3.

the two horizontal planes a difference can be measured which is due to the effects of gravity in accelerating the downward-moving and retarding the upward-moving molecules. In a stream of moving gas issuing from an orifice, it may be true that the majority of the molecules are moving away from the orifice, but there will still be a large number of molecules moving more or less transversely, as will be very plainly proved by the outward expansion of an issuing jet. Now, in turbine work it is essential to efficiency that the jet of steam impinging on the rotating wheel shall, if possible, consist of molecules moving in one line or in parallel lines exactly as the molecules of a jet of water move. The molecules of water possess no power of self-translation. They simply obey the laws of motion, and tend to move only in straight lines unless acted upon by some external deflecting force. By curving backwards the buckets of a Pelton wheel, the inert particles of water are turned about in direction relative to the wheel, and leave it at the same velocity at which they entered relative to the wheel, but at half the actual velocity. The wheel, therefore, has to move at half the speed of the jet, and the jet drops into the waste pit with no movement save that small lateral component of its velocity necessary to throw the jet clear of the wheel, and acquired because the buckets do not throw back the jet exactly parallel with its line of entry, their sides terminating at a small angle from the plane of revolution.

Now, with a jet of steam directed out of such a similar converging nozzle the jet will possess an internal pressure: that is to say, many of its molecules will possess movement more or less transverse to the direction of movement of the jet as such. Such transverse molecular movement is useless for propelling a wheel blade; the whole of the molecules must move in one direction. If they will do this, there can be no transverse movement, and if there is no transverse movement there can be no internal pressure of the jet. That is to say, the jet will not expand laterally, and if it will not expand it cannot be above the surrounding atmospheric pressure. If, therefore, steam can be made to travel as a jet at atmospheric pressure, it is obvious that all its molecules must be moving in one direction, and must be possessed of their full kinetic energy of motion, and free from pressure or a tendency to diffuse laterally. How can such motion be imposed on a jet?

Let us consider the case of an individual molecule. Being perfectly elastic, such a molecule will rebound from a hard unyielding surface at the same angle at which it impinges. Thus in fig. 1, if a parallel-sided jet be supposed and a molecule be moving in the direction of the arrow, it will produce angles of incidence and reflection a, b, c, d and e all equal, and when the end of the nozzle is reached, such a molecule will escape laterally at k. That is to say, the jet will flare out at the escape. Evidently a parallel-sided nozzle is wrong.

Let us next try the converging water nozzle as at fig. 2. Tracing out the path of a single molecule and making the angle b = angle a; $f = e$; $d = c$, we soon find the molecule travelling backwards in the nozzle, so that there is a tendency to increase of pressure in the narrow part of the nozzle. There now only remains to try a flaring-out nozzle of the form of fig. 3. Here, again, drawing equal angles of incidence and reflection, it rapidly becomes clear that if the nozzle is of any serious length, the molecule will very quickly be travelling in a direction not far removed from that of the centre line of the nozzle. The jet of steam has, in fact, been polarised, all its molecules moving in parallel lines without tendency to flaring out when they leave the nozzle.

Such a jet of steam now possesses its full velocity, and is expanded down to the pressure of the atmosphere. It is now in a condition to be directed upon the blades of a turbine, and this is just what is done in the case of the Laval turbine, the one fault of which is that we have no material from which to make a rotating disk that will move at half the velocity of the steam. In a multi-bladed turbine the action is split up among a large number of rings of blades, and, owing to friction and other causes, to the lateral expansion as the steam arrives at the longer blades, the stream lines become mixed up, the steam jets lose their kinetic energy, and the turbine loses its efficiency. Now in some turbines this proposition is recognised, and the steam, after passing some of the rings of blades is allowed to escape into an intermediate chamber, whence it is again directed through polarising nozzles which re-establish the jets, to be directed again on suitable larger blades. Steam cannot, in fact, travel very far and preserve unidirectional molecular movement. It must travel along a steadily enlarging nozzle in order to expand properly. Where it loses its correct movement and some of the molecules commence more or less transverse or backward movement there is impact against the back of the moving blades and consequent loss. Once destroyed, a jet of steam cannot regain its polarisation without a rest chamber and a fresh set of expanding nozzles. Just so far as a turbine fails in the conditions above outlined will it fall short of possible efficiency. All steam turbines must really act after the manner of the Pelton wheel. Except the

Laval, which fails only in velocity, most, or perhaps all, other turbines act like Pelton wheels upon which jets are directed other than tangential to the pitch circle and parallel to the plane of rotation.

A QUESTION OF FIGURES.

Our strenuous contemporary, the *Journal of Gas Lighting*, published, on August 28th, some comparative figures for gas and electric lighting in mills and workshops. The figures appear in the account of a paper read by Mr. A. Pollitt before the British Association of Textile Managers, so that we suppose that the *Journal of Gas Lighting* is not responsible for the fine confusion of statistics which, to us at any rate, appears to exist in the table submitted for comparison. This compilation reads as follows :—

20,000-c.p. Installation with a Lighting Season of 450 Hours.

Plant.	Total candle-power.	Capital expenditure.	No. of lights.	Candle-power per light.	Cb. ft. of gas per hour.	Price of gas per 1,000 cb. ft.	Cost per hour, gas only.	Up-keep per hour.	Interest and depreciation (5 per cent. each) per hour.	Total cost per hour.	Cost per 1,000 candle-power per hour.	Per unit.
		£ s. d.				s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	
Ordinary flat flame burner	20,000	468 15 0	1,250	16	6,250	2 6	15 7·50	0 6·50	2 1 00	18 3·00	0 0·219	—
Incandescent mantle ...	20,000	233 2 0	334	60	1,086	2 6	2 8·50	1 0·25	1 0·43	4 9·18	0 0·0571	—
Welsbach self-intensifying gas lamp	20,000	355 2 0	125	160	875	2 6	2 2·25	0 5·42	1 6·93	4 4·60	0 0·0526	—
Compressed gas	20,000	310 4 6	134	150	806	2 7	2 2 23	0 5 42	1 4·54	4 0·19	0 0·0481	—
					Watts.		Electricity.					
Electric incandescent ...	20,000	2,031 5 0	1,250	16	75,000	—	1 10·71	2 3·66	9 0·03	13 2·68	1 1·23	3·53
Electric arc	20,000	530 0 0	40	500	22,000	—	1 4·26	0 10·00	2 4·18	4 6·44	0 2·722	2·474

We take it that the "Total cost per hour" is the sum of the three preceding columns. If this is so, the arithmetic is slightly out in two cases; but such a mishap could befall even a professor.

It is when we come to the "Cost per 1,000 candle-power per hour" that we get into troubled waters. The figures shown in this column should, so far as we can see, be the result of dividing the figures in the previous column by 20, inasmuch as the total candle-power of each installation is assumed to be 20,000. If, however, we do this, we find that, instead of the cost of electric incandescent lamps being rather over 60 times that of ordinary flat-flame burners, and about 230 times that of incandescent gas mantles, as shown by the table, the actual costs per 1.000 c.p. per hour, calculated from the previous columns, are as follows :—

Ordinary flat-flame burner	10·95d.
Incandescent mantle	2·85d.
Welsbach self-intensifying lamp	2·53d.
Compressed gas...	2·409d.
Electric incandescent	7·92d.
Electric arc	2·722d.

This—to put it gently—makes a difference.

A further examination of the figures reveals some interesting points in the "comparison." For example, the type of electric arc giving 500 c.p. per light, which has been chosen for consideration by Mr. Pollitt, is seemingly the enclosed (double-globe) type taking 550 watts per lamp. His reason for using these where "large areas are to be lighted without much obstruction" is that "the working of the smaller lamps is more expensive for their candle-power than is that of the large ones, but a better general illumination is obtained by having more lamps of smaller capacity." Now it has been the experience of a large number of engineers that the open-type arc, more particularly when provided with a suitable reflector, gives all the diffusion necessary to "large areas without much obstruction," such as are to be found in many mills and shops. In view of the four alternative methods of gas lighting, common fairness demands that the cost of open-type arc lamps, and flame arc lamps burning with "white" carbons, should be submitted. Failing this, the comparison is unjust.

Even more glaring is the way in which the cost of incandescent electric lighting is worked out. A figure of £2,031 5s. is taken as the capital expenditure on an installation dealing with 75 kw. This is, moreover, on the assumption "that the power is available, and that the dynamo only has to be supplied." Now a 75-kw. set, with engine complete, is *listed* by a standard engineering firm at £845. Twenty per cent. off this is nearer the actual cash price. The cost of 1,250 mill lights at 7s. 6d. apiece is £470. Allowing for labour, foundations, and contingencies, a figure of £155, we arrive at a sum, with an *engine included*, of £1,300. Now, Mr. Pollitt takes interest and depreciation at 5 per cent. per annum each on his capital outlay, and, of course, gets a magnificent total of 9s. 0·03d. per hour (with 450 working hours per year) as the expense on his installation from this cause alone. If £1,300 be taken, however, this figure comes down to 5s. 9·3d., bringing the total cost per 1,000-c.p. per hour to 5·98d., as against the figure given of 1/1·23. This, be it noted, is on an isolated plant running only 450 hours out of a possible 8,760, as compared with gas installations whose standby charges are practically *nil*. If power were taken by the mill from a supply company whose plant was running fairly constantly night and day, the cost of lighting, under any modern contract for mill power and lighting, would be more in the nature of 1¼d. or 1d. or lower (depending on the size and load-factor of the mill) rather than the price of 3·53d. per unit quoted by this writer.

After this, the charging of 2/3·66 per hour towards upkeep of a 1,250 glow lamp installation, although gross, seems insignificant.

It does not appear to us that the table under consideration reflects credit either upon its author, the society to whom it was delivered without (so far as we are aware) any objection to its statements being made, or the journal which published it without further explanation or comment. Is it a piece of gross carelessness, wilful perversion, awful incompetence, or what?

Electrical Driving of Rolling Mills.—It is announced that an electric reversing rolling train was recently put in operation at the iron and steel works of the Archduke Friedrich at Teschen, Austria. The installation is claimed to be the first of its kind and to have passed through its trials exceptionally well down to the present time. The work, which was carried out by the Berlin General Electricity Co., has resulted in the receipt of new orders for similar rolling trains from a Hungarian works and a large German steel works, each order representing a value of from £25,000 to £50,000. This announcement apparently refers to the plant at the Hildegarde Hutte, which was started in regular operation on July 27th. The application of electric driving to rolling-mill reversing trains is said to have brought about the complete centralisation of the production of electrical energy at ironworks, as the reversing steam rolling train engine has hitherto been the sole engine which has maintained its position notwithstanding the varied applications of the electrical transmission of power. The reversing train serves the purpose of rolling heavy ingots, about two tons in weight, into billets, double tees and rails, the available power being 10,000 h.p. The maximum speed of the train amounts to 120 revolutions per minute, and its acceleration from nil to this speed is normally attained in four seconds, although it can be reached in two seconds and a half in case of necessity. No instance is said to have occurred of an ingot sticking fast, whereas this could not quite be avoided with steam power. The production of the mill is claimed to be 10 per cent. higher than when driven by steam engines.

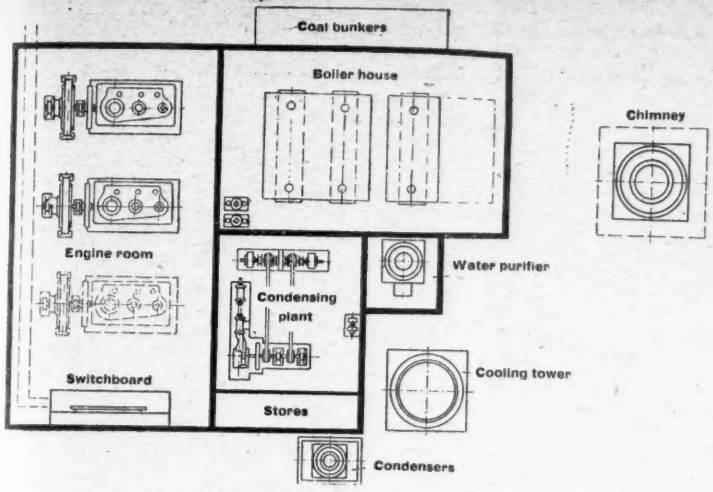
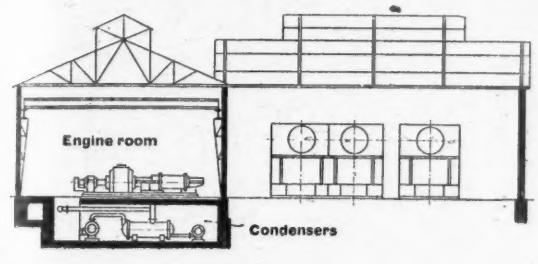


Fig. 1.—Plan of Station, Reciprocating Steam Plant.



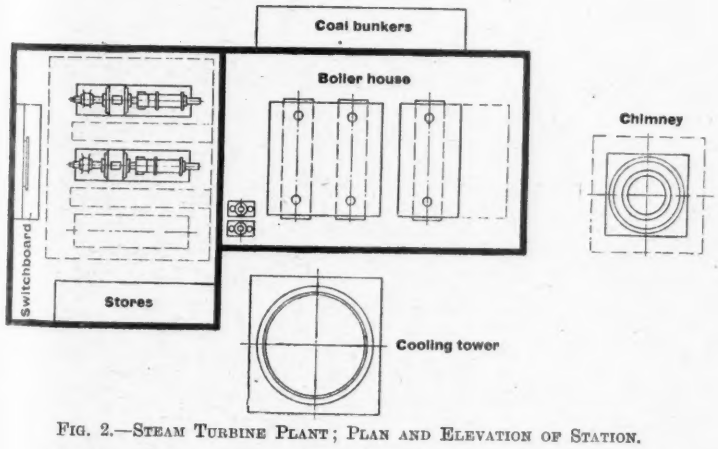


Fig. 2.—Steam Turbine Plant; Plan and Elevation of Station.

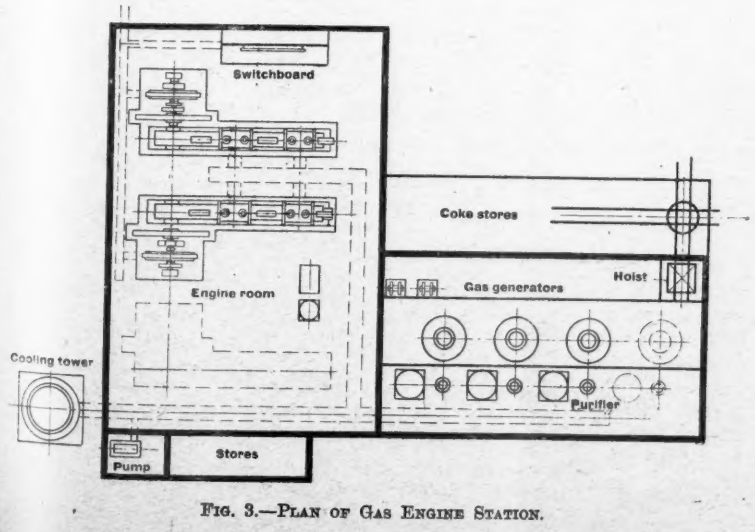


Fig. 3.—Plan of Gas Engine Station.

THE COMPARATIVE COST OF STEAM ENGINES, STEAM TURBINES, AND GAS ENGINES FOR WORKS DRIVING.

A useful set of comparative cost tables is given by W. Schömburg in a recent number of the *Elektrotechnische Zeitschrift*. The case considered is that of a large works at present driven by numerous independent steam engines. A new direct-current electric supply station for power and lighting purposes is to be erected. The day load, assuming that half of the machinery is at work at one time at its ordinary load, is taken as 900 kw., and the night load is about 250 kw. No spare plant is to be installed, as a small electric plant with battery is available in case of breakdown, but future extensions are to be allowed for.

Coal at 18s. a ton delivered, and having a thermal value of 12,500 B.Th.U. per lb., is obtainable, and also coke at 23s. a ton and of 11,700 B.Th.U., whilst the cost of water (from the company's own supply) is 2·7d. per 1,000 gallons.

Assuming that the future extensions amount to half the present power and that the future night load will not exceed one-third of the future day load, it will be advantageous to install two 440-kw. machines rather than a single 900-kw. one. A third similar 440-kw. set can then be added later. Allowing for 300 working days in the year with 10-hour day shifts and 8-hour night shifts, the total units used will be :—

Day shifts, $440 \times 2 \times 10 \times 300$	= 2,640,000 B.T.U.
Night shifts, $250 \times 8 \times 300$	= 600,000 B.T.U.
Total annual units ...	3,240,000

The two generators will be approximately fully loaded during the day, while one alone will be run during the night, and will be only partly loaded.

I. — Using Reciprocating Steam Engines. (Fig. 1.)—The engines are assumed to be of the three-crank triple-expansion type running at 140 r.p.m., and working condensing with superheated steam at 180 lb. per sq. in. and a temperature of 250° to 275° C. The steam consumption at full load (allowing for the fact that the engines will not be running at quite full load constantly) is taken as $11\frac{1}{2}$ lb. per I.H.P.-hour, which, with a dynamo efficiency of 92 per cent. and an engine efficiency of 88 per cent. (combined efficiency of 81 per cent.), gives $19\frac{3}{4}$ lb. per kw.-hour. At night (working at about half load) the consumption will be about $22\frac{1}{4}$ lb. per kw.-hour. The total steam consumption at full load will thus be 17,700 lb. per hour, or, allowing for condensing machinery, feed pumps and pipe condensation, say, 21,000 lb. per hour. When the third machine is added the consumption will rise to about 31,000 lb. per hour.

The condensers employed would be jet condensers and the condensing water would be cooled in wooden cooling

towers and used over and over again—the maximum quantity to be circulated (when the third generating set is in use) being about 60,000 gallons per hour. The condensing machinery would be driven by a 50-H.P. single cylinder engine, and the two feed pumps would also be steam driven.

Three water-tube boilers with a heating surface of 2,700 sq. ft. each would be required, and the boiler house would have room for a fourth. Each boiler would be fitted with its own superheater for about 85° C. of superheat, but no economiser need be provided, as the feed water could be warmed by means of the exhaust steam from the feed pumps. A 24-in. exhaust steam main would be required. The details of the cost of this installation are as follows :—

CAPITAL EXPENDITURE.

(1) Two steam dynamos	£10,800
(2) Three water-tube boilers, with superheaters ...	3,000
(3) Condensing plant	2,300
(4) Feed pumps and oil separator	650
(5) Live and exhaust steam mains	375
(6) Feed water and cooling water piping	275
(7) Overhead hand driven crane for about 10 tons and 40-ft. span	210
(8) Switchboard and connecting cables to dynamos ...	350
(9) Coverings for pipe troughs	150
(10) Spare parts for engines, &c.	300
(11) Coal trucks, ash trucks, rails, weighing machine, &c.	550
(12) Engine room, 33 ft. high and 3,800 sq. ft. area ...	1,225
(13) 5,200 sq. ft. boiler and pump house	1,320
(14) Foundations for the steam dynamos, &c.	725
(15) One chimney shaft, 160 ft. high and 8 ft. internal diameter at the top	900
(16) Boiler brickwork	600
Total	£23,730

The capital cost per KW. installed is $\frac{23,730}{880}$ = £27, or allowing for the future extensions, it is about $\frac{30,750}{1,320}$ = £23 10s per KW.

ANNUAL RUNNING EXPENSES.

(1) Coal consumption :— 2,640,000 KW.-hours at $19\frac{3}{4}$ lb. of coal per KW.-hour, and 690,000 KW.-hours at $22\frac{1}{4}$ lb. of coal per KW.-hour	4,212	tons.
Heating-up (10%)	423	,,
Feed pumps and condensing plant	425	,,
	5,060	tons.
At 18s. per ton		£4,504
(2) Lubrication and packing		440
(3) Stoking, engine driving and supervision		1,250
(4) Water purification		45
(5) Upkeep and repairs { 3% on items (1) to (6) of capital cost		522
(5) Upkeep and repairs { 2% on items (7) to (11) and item (16)		43
(5) Upkeep and repairs { 1% on items (12) to (15) ...		42
(6) Depreciation 7% on items (1) to (9), (11) and (16)		1,348
,, 3% ,, (10) and (12) to (15) ...		134
(7) Interest on capital at 4%		949
Total ...		£9,327

Cost per KW.-hour therefore = ·69d.

II.—Using Steam Turbines. (Fig. 2.)—Two units of 440 KW. running at 2,100 revs. per min. (Parsons turbines) will be installed and will require about two-thirds of the above engine room space. The steam consumption, allowing for the improved condensation required (about 90 per cent. vacuum), will be slightly higher than for the triple-expansion engines. Each turbine will have its own condenser fitted close to it, and the condensing water cooler will have to deal with a maximum of about 115,000 gallons per hour. Upkeep and repairs will be about half as great as for the reciprocating engines. Lubrication will be greatly reduced and less attendance will be necessary, since in recent turbo-dynamos the commutation troubles have been successfully overcome. Comparatively light foundations will be required for the turbo-dynamos, but the boiler house equipment will remain practically unaltered.

CAPITAL EXPENDITURE.

(1) Two turbo-dynamos	£7,000
(2) Three water-tube boilers, with superheaters ...	3,000
(3) Condensing plant	2,800
(4) Hot well and feed pumps	340
(5) Live and exhaust steam mains	275
(6) Feed water and cooling water piping	250
(7) Overhead hand-driven crane for about 7½ tons and 36 ft. span	170
(8) Switchboard and connecting cables to dynamos ...	325
(9) Coverings for pipe troughs	175
(10) Spare parts for turbines, &c.	150
(11) Coal trucks, ash trucks, rails, weighing machine, &c.	550
(12) Engine room, 23 ft. high and 2,350 sq. ft. area ...	775
(13) 2,350 sq. ft. boiler house	605
(14) Foundations for the turbo-dynamos, excavations for the condensers, &c.	475
(15) Chimney shaft, 160 ft. high and 8 ft. internal diameter at the top	900
(16) Boiler brickwork	600
Total	£18,790

The capital cost per KW. installed is thus £20 18s.
All the prices include freight and erection.

ANNUAL RUNNING EXPENSES.

(1) Coal consumption, including feed pumps, 10 per cent. for heating up and condensation loss = 5,417 tons	£4,875
(2) Lubrication and cleaning material	80
(3) Stoking, engine driving and supervision ...	1,125
(4) Upkeep and repairs { 1½% on item (1) of capital cost	105
(4) Upkeep and repairs { 3 % on items (2) to (6) ,,	292
(4) Upkeep and repairs { 2 % ,, (7) to (9) (11) and (16)	36
(4) Upkeep and repairs { 1 % ,, (12) to (15) ,,	28
(5) Depreciation 7% on items (1) to (9) and (11) and (16)	1,084
3% ,, (12) to (15)	83
(6) Interest on capital at 4%	736
Total	£8,444

Cost per KW.-hour therefore = ·625d.

III.—Using Gas Engines. (Fig. 3.)—Two gas engine dynamos for 440-KW. each will be required, and these would preferably be of the 4-cycle double-acting type with tandem arrangement of cylinders though single cylinder engines could be used. The speed would be 130 revs. per min. Starting would be effected by compressed air provided by a small electric pump and air cylinder. The necessary cooling water would amount to about 9 gallons per H.P.-hour, so that cooling arrangements for dealing with a maximum of 20,000 gallons per hour (when three generators are in use) must be installed, and this amount of water must be cooled from about 40° C. to 25° or 28° C.

Three power gas generators would be erected (one as a spare) with the necessary steam raising plant, purifiers, &c. Each generator should be amply large enough for 600 H.P., and with an efficiency of 75 to 80 per cent. each generator would require about 7,800 lb. of coke per day of 10 hours. Consumption tests on engines of this size are not yet available, but taking the guarantee figures of well-known makers, the consumption of coke should not exceed 1·65 lb. per KW.-hour at full load, or 2·45 lb. per KW.-hour at half load. To allow for the losses in banking one gas generator during the night, an addition of 10 per cent. of the full load consumption must be made. The lubrication expenditure will be somewhat greater than for the triple-expansion steam engines, whilst the attendance expenses will be less owing to the absence of condensing plant. The foundations will, however, have to be more substantial.

CAPITAL EXPENDITURE.

(1) Two gas dynamos for 440 KW. each	£11,250
(2) Three gas generators with purifiers, steamers, electric blowers, piping and valves	1,350
(3) Compressed air plant for starting	310
(4) Cooling water plant with electric centrifugal pump, iron cooling tower and piping	725
(5) Overhead hand-worked crane for 10 tons and 53-ft. span	275
(6) Gas and air piping, exhaust chambers and valves for the engines	275
(7) Switchboard and cables from the dynamos... ...	375
(8) Coverings for pipe troughs	290
(9) Spare parts for the engines and dynamos	450
(10) Weighing machine, rails, coke hoist, coke trucks, &c.	800
(11) Engine room, 30 ft. high and 5,400 sq. ft. area ...	1,750
(12) Gas generator room, 3,600 sq. ft. area	910
(13) Foundations and pipe troughing	1,100
Total	£19,860

The capital cost per KW. installed is, therefore, £22 10s.

Annual Running Expenses.

(1) 2,640,000 kw.-hours, at 1·65 lb. of coke per kw.-hour, and 600,000 kw.-hours, at 2·45 lb. per kw.-hour + 10 per cent. loss in gas generator = 2,810 tons of coke, at 23s. per ton	£3,232
(2) Lubrication and cleaning material	525
(3) Attendance and supervision	1,100
(4) Water for the purifiers (12,000,000 gallons per year at 2·7d. per 1,000 gallons)	135
(5) Upkeep and repairs—	
3% on items (1) and (2) of capital expenditure ...	378
2% „ (3) to (8) and (10) „ ...	61
1% „ (11) to (13) „ ...	38
(6) Depreciation 7% on items (1) to (8) and (10) ...	1,096
3% „ (11) to (13)...	112
(7) Interest on capital expenditure at 4%	794
Total	£7,471

The cost per kw.-hour is, therefore, ·55d.

The above figures show that in this case the steam turbines lead to the lowest capital cost, but that the gas engines give a lower annual cost. The writer points out, however, that no general rule can be laid down since the price of fuel, the overloads to which the plant is subjected, the value of floor space and other similar variables enter into the question and make it necessary to consider each case in detail in the way outlined above.

CORRESPONDENCE.

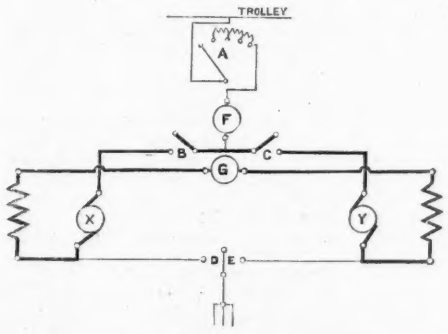
Letters received by us after 5 p.m. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Series Motor-Generator Tests.

I beg to submit to your notice an account of the above which I think will prove interesting to your readers.

Being desirous of giving my street car-motors a full-load test, in addition to the usual h.t. test, and not wishing to incur the expense of current supply and troubles incidental to the different types of power-absorption dynamometers, I arranged my two types of motors (respectively G.E. 800, and G.E. 58) with a mechanical connection of belt and pulleys.

The motors under test, see diagram, were so connected that they ran in opposite directions, the mode of operation being as follows :—Pulleys (of a ratio previously determined by experiment) were placed on the armature shafts, the belt slipped on, and switches B, E and A (first step only) closed. This makes the G.E. 58 machine into a series-generator with a separately-excited field, driven by the G.E. 800 motor, and



F, Outside supply ammeter; G, Main ammeter; X, Motor G.E. 800; Y, Motor G.E. 58.

on switch C being closed, current is supplied (owing to the higher voltage of the generator) to the motor ; the resistance in switch A may then be cut out, and the whole combination run clear across the mains with full load current through the motor. Then current on main ammeter (70 amperes) minus current on outside supply ammeter (35 amperes) = 35 amperes output of generator.

$$\sqrt{\frac{\text{output of dynamo}}{\text{input to motor}}} = \sqrt{\tfrac{35}{70}} = 71 \text{ per cent. efficiency.}$$

Although this arrangement may also be used for an efficiency test as above, it must be observed that the power absorbed by belt slip (for which no allowance has been made) is recorded on the outside supply ammeter, and must be taken into consideration ; but as the determination of efficiency was not the object aimed at, no special effort was made to secure entire freedom from slip. This, connected with the fact of two different types of motors being under test, will account for the low efficiency.

It will be seen from the diagram that the arrangement admits of this test being reversed, viz., switches C, D and A (first step only) closed, thus driving G.E. 800 as a generator by motor G.E. 58.

If a varied load is required, it may be obtained by step-cone pulleys, or shunting the generator field ; I prefer the former method, as it leaves the generator connections under normal working conditions, avoiding sparking troubles owing to a weak field.

I am not aware that this test has been tried before ; if it has, it would be interesting to know the results obtained, and why it was not universally adopted.

The Colombo Electric Tramways and Lighting Co., Ltd.

William Heap,
Workshop and Car-shed Superintendent.

Colombo, Ceylon,
August 14th, 1906.

[The test described is, of course, a modification of the Hopkinson test, and is very widely used in various forms. The testing of tramway motors in pairs was very fully discussed by Mr. M. B. Field in a paper read before the I.E.E., and reported in the Electrical Review for October 31st, November 7th, 21st and 28th, and December 5th, 1902.—Eds. E.R.]

Railway Engineers and Electricity.

I was pleased to see your comments on the paper by Mr T. Hurry Riches and Mr. S. B. Haslam, read at the Cardiff meeting of the Institute of Mechanical Engineers.

As one who had the privilege of attending those meetings, I regret to say that one could not but be impressed by the narrow way in which matters electrical were treated. During the discussion on "Dock Appliances," an electrical engineer dared to suggest that electricity might with advantage be used for certain of the operations. His statements were treated with ridicule, many wild statements being made as to the very frequent breakdowns of electrical machinery.

For instance, Mr. T. Hurry Riches spoke of his "wretched" electrical contrivances, stating in all seriousness that they broke down a hundred times for once in the hydraulic machinery. If this is true, it shows that either Mr. Riches has had some foreign "jerry" machinery palmed off on him, or else—and what I believe is more likely to be the case—those in charge and those who carry out minor repairs do not understand its use.

I have had many opportunities of seeing this machinery, and can assure you that Mr. Riches was justified in terming it "wretched." This does not cast any reflection on electrical machinery, but shows the folly of placing such machinery in the hands of those who do not understand it.

With regard to the paper on "Railway Motor-Cars," in the table comparing steam cars with electric traction, in the first case only one car is considered, and, naturally, the results are in favour of steam cars.

If a railway company proposed to use electric traction on a branch line, it would be very absurd to use only one electric car and fill up with ordinary steam cars.

What engineer would for a moment entertain the idea of building a power station for one car ? Of course, the results would not have been favourable to steam cars had the comparisons been made on a fairer basis.

It is rather surprising to learn in the Electrical Review of August 3rd, 1906, that the Midland Railway "proposes to adopt single-phase alternating current in connection with the electrification of the company's line between Lancaster and Heysham Harbour. . . . It is intended to run an electric service for local traffic only, *replacing the steam rail motor cars now in use.*"

What has Mr. Riches to say to this? Does he suppose that the Midland Railway Co. has not gone thoroughly into the subject?

P.

A Curious Experiment.

In your issue of August 24th you publish a letter signed G. Vaughan, concerning an interesting experiment made by heating one end of some copper wires while keeping the other end cool. The writer says that when this is done in a strong magnetic field, he obtains a voltage of 2½ to 3 volts, but when the experiment is performed without the magnetic field, no result in voltage is obtained.

I am interested in thermo-electricity, and have experimented considerably in it, but I completely fail to get his result when I try a similar experiment, nor do I find that a magnetic field makes the slightest difference to the action of a thermopile.

I have by me several small thermopiles, so to test the matter I selected one, heated it, and placed it between the poles of an electro-magnet, then noted the voltmeter reading. I then switched off the current from the magnet, but the volts of the thermopile were just the same on the meter. No difference was made to the reading, whether the field were present or absent, not do I see how it could possibly be otherwise. If the earth's field affects the action of a thermopile, as suggested by Mr. Vaughan, would it not follow that the relative position of the thermopile with respect to the direction of that field would affect its performance? But it is well known that this is not the case.

I presume that it is quite certain that Mr. Vaughan did not place his conductors in an alternating or fluctuating field when making his experiments, as this would account at once for his 2½ to 3 volts. Such voltages are not in the range of thermo-electricity as at present it is known, the highest practically obtainable from a single junction approximating to about one-tenth of a volt.

A. N. Hazlehurst.

London, S.W., *August 29th*, 1906.

WARNER'S SINUOUS TRUCK.

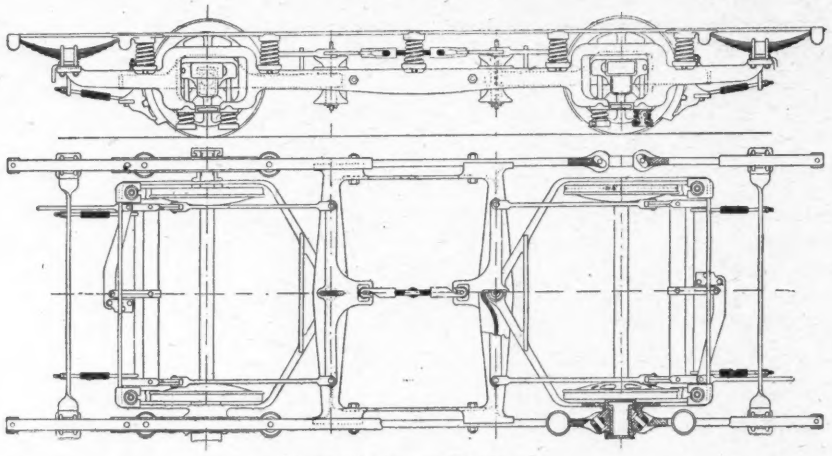
We know the rigid, the bogie and the radial truck, but what is a "sinuous" truck?

To our readers' mental query, which we have formulated in the foregoing sentence, we may briefly reply that the sinuous truck is one which is intended to combine the advantages of all the rest, without embodying their respective disadvantages or introducing drawbacks of its own. To what extent this object has been attained must be, and is now being, determined by the practical test; on this head we can only say that the design appears to be well deserving of trial, and likely to survive the ordeal. The following brief description will enable our readers to form their own opinions.

As will be gathered from the accompanying plan and elevation of the truck, the main principle is the same as that of the radial trucks which have been before the public and have been widely used during the past two or three years—namely, a rigid frame fitted with two single-axle bogies, swivelling on fixed centres, so as to accommodate the wheel-base to the curvature of the track, and capable of being built with a wheel base twice as long as that of the ordinary rigid four-wheel truck. The special feature of the "sinuous" truck resides in the mode of suspension of the weight of the car from the axle boxes by means of links.

It will be seen that each axle is carried in a sub-truck, which is connected to the main frame by a rigid king-pin fixed on the centre line of the car, and is thus free to swing from side to side. The motor (not shown in the figure) is slung between the axle and the apex of the sub-truck in the usual way, and swings with the axle. The propelling force is transmitted from the sub-trucks to the main frame and car-body through the king-pins.

This connection alone is insufficient to maintain the car body in proper alignment with the track, and to prevent it from oscillating from side to side; various means have been adopted to provide the necessary restraint, with more or less success. In the present



Warner's Sinuous Truck.

instance the weight of the main frame and car body is suspended from the axle boxes by links, normally vertical, and about 12 in. in length. These links, as shown in section in the plan, are pivoted on radii passing through the king-pin, and permit the sub-trucks to be deflected from the central position with the minimum of friction; at the same time, as any deflection of the links from the vertical position raises their lower extremities, and therefore raises the car-body, there is always a restoring force due to the weight of the car tending to bring the sub-trucks into alignment with the car-body. It is claimed for this device that its perfect freedom of movement, combined with its definite and smooth pendulum action, enables the four wheels to adjust themselves freely not only to the tangents to the track on curves, but also to the sinuosities which are met with even on nominally straight track, while the car-body moves symmetrically over the centre line of the track, without oscillation or deflection. The self-aligning action of the link suspension ensures that the sub-trucks shall maintain a practically central position on straight track without depending solely upon the flanges for this purpose; thus friction and wear of the flanges and rails are minimised, and this is claimed as a very valuable feature of the device.

The design of the truck in other respects follows the ordinary lines, and need not be discussed in detail.

The first truck of this pattern was designed to the order of the L.C.C. some months ago, with a view to trying it in place of a pair of bogie trucks. Others have also been put in hand, including one with a wheel-base of no less than 13 ft. 6 in. A car equipped with a Warner truck has been in operation on the Corporation tramways at West Ham for several months, and we are informed that the results have been highly satisfactory, as regards both the easy running and noiselessness of the cars and the reduction of wear on the wheels and rails.

It is regrettable that we should have to state that although the inventor has received very favourable opinions on his truck from leading tramway engineers in England, America and the Continent, and several foreign firms have offered to build trial trucks with a view to securing orders which are actually in sight, no British manufacturer has yet shown any serious interest in the subject. Consequently, while "sinuous" trucks of foreign manufacture may be purchased, or existing radial trucks converted by direct licence from the patentee (Mr. J. S. Warner, Glen Deep, Disraeli Road, Forest Gate, Essex), they are not yet made in this country. We understand, however, that negotiations are in progress which may result in a favourable outcome.

Arc Works Extensions.—Chelmsford T.C. has passed plans of extensions of the lamp department at the arc works of Messrs. Crompton & Co., Ltd.

A SECTIONAL SUPERHEATER.

A device intended to obviate some of the disadvantages appertaining to flue superheaters as ordinarily made has been introduced by Messrs. James Gordon & Co., of 81-83, Knightrider Street, E.C., under the name of "Ferguson's patent."

As will be seen in the accompanying illustrations, the arrangement of the parts is quite different from that of the customary designs. The headers are of wrought-steel, and the superheater-pipes are grouped in sections, each of which is separately attached

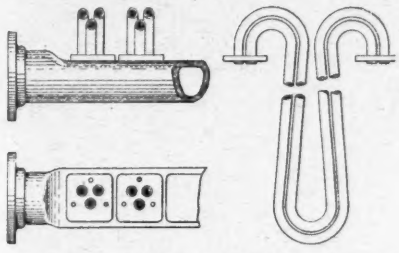


Fig. 1.—Detail of Header, and a Section of the Superheater.

to the headers by means of ordinary faced joints, secured with studs and nuts (fig. 1). The joints being on the tops of the headers, they can be inspected at any time, and any section can readily be removed for repair without disturbing the rest; moreover, either a spare section can be inserted in its place, or the openings can be blanked off, and the superheater returned into use at once.

Each section consists of three pipes, expanded into two small end plates, and weighs about 120 lb, so that one man can handle it (see fig. 2). The headers can be put in place first and connected

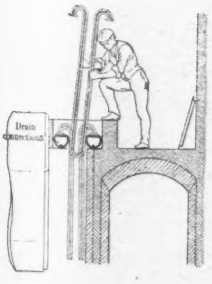


Fig. 2.—Method of Handling Sections.

to the steam range, after which the sections can be bolted on singly. Obviously the small joints are easily made, and can as easily be broken, whereas in many types of superheater the joint extends the whole length of the header, and is difficult to make or break. The stoppage of boiler and superheater to withdraw or renew a section is reduced to a minimum duration.

The arrangement of the headers enables them to be adequately drained, and they act also as separators, water of priming or condensation collecting in them instead of in the tubes; the situation of the drain connections is shown in the figures. The joints are entirely out of the way of the flue gases. Access to the back flue chamber can be obtained by removing two or three sections only, instead of lifting out the whole superheater. As all the parts are comparatively small and light, transport is easy; and there are no tubes to be expanded in position in the process of erection. The superheater can be adapted to all types of boilers; fig. 2 incidentally shows its position in the flue of a Lancashire boiler, while fig. 3 shows it applied to a water-tube boiler of the Stirling type, and fig. 4 to a Babcock & Wilcox boiler. The degree of superheat obtained can be controlled by suitably varying the number of sections in use.

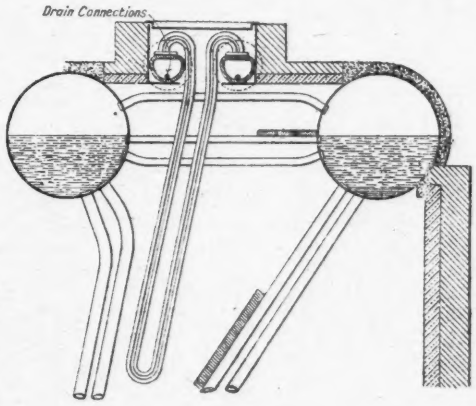


Fig. 3.—Application to Stirling Boiler.

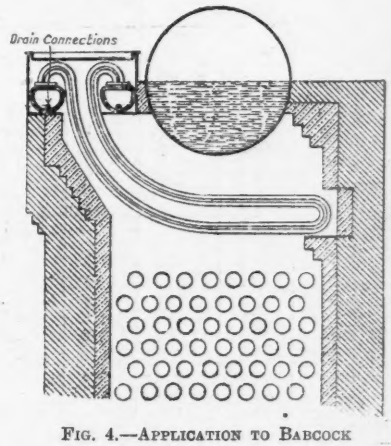


Fig. 4.—Application to Babcock and Wilcox Boiler.

British Manufacturers' Success.—The jury of the International Exhibition held at Tourcoing, which is the centre of the textile and allied industries in France, has awarded a gold medal to the Brush Electrical Engineering Co., Ltd., of Loughborough, for a large exhibit of electrical machinery specially adapted for textile work.

SODIUM PRODUCTION.

By Edgar A. Ashcroft.

For many years attempts have been continually made to reduce metallic sodium directly from common salt by an electrolytic process. Up to the present time no successful method has come into use on an industrial scale, the old Castner process still holding the field. This method consists of the electrolysis of fused caustic soda, the total cost incurred being about 14·5 cents for every pound of metal produced. The caustic soda is an expensive item, as it can be used only in a pure state. Common salt, on the other hand, is easily obtainable even in a high state of purity, and is, as a consequence, an ideal source of sodium. The process here described consists of a combination of two methods. The first stage consists of the formation of a sodium-lead alloy by the electrolysis of fused salt ("Electro-chemical and Metallurgical Industry," Vol. IV., No. 6) with a fused lead cathode. The second is the refining process, the lead-sodium alloy being made the anode, pure fused soda the electrolyte, and a copper or nickel sphere the cathode. The total cost of production is estimated at 5·9 cents per pound of metal. The plant in use consists of two cells joined together at the bottom, whereby the whole process is made continuous. Both are lined with suitable refractory material, and are heated externally. The current passes round the first cell to the anode suspended at the centre, and sets up a strong magnetic field in the interior of the bath. The lines of force run perpendicularly, and the current in the fused lead cathode at the bottom of the cell cuts them at right angles, causing a circular motion in the fused metal. Thus, after the fusion of the introduced charge of salt the current deposits sodium in the stirred-up lead cathode, in which it is evenly distributed. The main current then passes along the metal junction to the refining cell. Here the anode consists of the fused lead-sodium alloy prepared in the first cell. Fused caustic soda forms the electrolyte, and a hollow nickel sphere running through the bottom of the bath is made the cathode. The hollow part of this latter offers a cooling surface which solidifies the bath round the joints and forms an effectual seal. Over the cathode a nickel funnel is suspended to catch the sodium as it rises, and protect it from the oxidising influence of the air. This has an overflow at the top, down which the molten metal may run into a suitable non-oxidising medium. This hood forms part of the anode system, to confine the whole of the metallic deposition to the hollow sphere, and thus avoid the formation of sub-oxides.

In this way sodium goes into solution at the anode, and is deposited at the cathode without changing the constitution of the bath. The metallic connection between the two cells consist of a composite pipe for the inflow and backflow of the molten alloy, which is kept in motion by the circulation set up in the cells. The working temperature in the first is about 700° C., but it is somewhat lower in the regene-

rating bath. Thus the hot metal leaving the first cell heats up the colder impoverished alloy, and no clogging of the system is caused.

LAMPS WITH METALLISED FILAMENTS.

At the twenty-ninth convention of the National Electric Light Association (U.S.A.) held last June in Atlantic City, Mr. Francis W. Willcox read a paper entitled: "Higher Efficiency Incandescent Lamps: their Value and Effect on Central Station Service." Although the title of the paper would lead one to expect a general examination of the claims to precedence of all the newer higher efficiency lamps, yet the author confines himself almost entirely to the subject of the relative merits of the new Gem metallised filament lamp and the ordinary everyday carbon filament lamp. This comparison is made by Mr. Willcox with great thoroughness.

TABLE II.—Useful Life and Lamp Renewal Costs per Kilowatt-Hour of the present 16-c.p. ordinary carbon filament lamp, and the new 16 and 20-c.p. Gem filament lamps, at various initial inefficiencies.

Mean horizontal inefficiency in watts per candle.	Total watts for 16-c.p. lamp.	Values for the present 16-c.p. ordinary carbon filament lamp at price of 16 c.		Values for the new Gem filament 16 and 20-c.p. Price 20 c.		
		Useful life in hours.	Lamp renewal cost per kw.-hour in cents.	Useful life in hours.	Lamp renewal cost per kw.-hour in cents.	
					16-c.p. lamp.	20-c.p. lamp.
2·0	32·0	—	—	125	5·0	4·0
2·1	33·6	50	9·52	177	3·3	2·7
2·2	35·2	66	6·89	233	2·44	1·95
2·3	36·8	86	5·50	304	1·788	1·43
2·4	38·4	111	3·76	392	1·325	1·06
2·5	40·0	143	2·80	506	1·000	0·80
2·6	41·6	177	2·17	627	0·763	0·614
2·7	43·2	223	1·66	789	0·588	0·469
2·8	44·8	275	1·30	972	0·458	0·367
2·9	46·4	337	1 02	1,193	0·360	0·289
3·0	48·0	413	0·81	1,458	0·298	0·228
3·1	49·6	500	0·64	1,766	0·229	0·183
3·2	51·2	595	0·52	—	—	—
3·3	52·8	715	0·42	—	—	—
3·4	54·4	850	0·34	—	—	—
3·5	56·0	1,050	0·27	—	—	—
3·6	57·6	1,200	0·23	—	—	—
3·7	59·2	1,400	0·19	—	—	—
3·8	60·8	1,620	0·16	—	—	—
4·0	64·0	2,100	—	—	—	—

The author starts by stating that a 2·5-watt metallised filament lamp has the same useful life as a 3·1-watt ordinary carbon filament lamp, this being the inefficiency most affected in the United States. The saving to be effected by the use of the new filament is therefore about 20 per cent. It must be remembered, however, that throughout the paper the author refers to lamps of 110 volts pressure. It is not stated whether the new filaments can be made equally satisfactorily for 220 volts.

The new lamps are at present made in two grades, namely, of 16 c.p., consuming 40 watts, and of 20 c.p., consuming 50 watts. The consumer can therefore obtain the same candle-power as hitherto with a saving of 20 per cent. in his energy bill, or with the same bill he can obtain an increase of 25 per cent. in his light.

Throughout the paper the cost of the new lamps is taken at 20 cents and the cost of ordinary lamps at 16 cents. From these figures, and taking the starting inefficiencies as 2·5 and 3·1 watts per candle-power respectively, the useful life being the same in either case, the saving to be effected on changing over to the new lamps can readily be calculated for various rates of charging per unit.

Table No. II, copied from the paper *in extenso*, shows contrasted the useful life and cost of renewals for ordinary 16-c.p. lamps, and for the 16 and 20-c.p. Gem lamps. The useful life of a lamp is taken in this table and throughout

TABLE III.—Saving of Higher-Efficiency Lamps over 3·1-w.p.c. Lamps in Cents per 1,000 Hours of Service of a 16-c.p. Lamp.

Rate per kw.-hr. in cents.	2 w.p.c.	2·1 w.p.c.	2·2 w.p.c.	2·3 w.p.c.	2·4 w.p.c.	2·5 w.p.c.	2·6 w.p.c.	2·7 w.p.c.	2·8 w.p.c.	2·9 w.p.c.	3·0 w.p.c.	3·1 w.p.c.
1	18	16	14·4	12·4	11	10·0	8·0	6·0	4·5	3 0	1·5	00
2	35	32	28·8	24·8	22	19·0	16·0	12·0	9·5	6·0	3·0	00
3	53	48	43·2	37·2	34	29·0	24·0	19·0	14·2	9·4	4·5	00
4	70	64	57·6	49·6	45	38·8	32 0	25·0	19·1	13·6	6·2	00
5	88	80	70·0	62·0	56	48·0	40·0	32·0	24·0	16·0	8·0	00
6	105	96	86·4	74·4	67	57·5	48·0	38 5	29·0	19·0	9 5	00
7	123	112	100·8	86·8	79	68·5	56·0	45·0	33·6	22·3	11·0	00
8	140	128	115·2	99·2	90	78·0	64·0	51·0	38·5	25·6	12·8	00
9	158	144	129·6	101·6	101	86·5	72 0	58·0	43·0	29·0	14·4	00
10	176	160	144·0	124·0	112	96·0	80·0	64·0	48·0	32·0	16·0	00
11	194	176	158·4	136·4	123	105·5	88·0	70·0	52·8	35·0	17·8	00
12	211	192	172·8	148·8	134	115·0	96·0	77·0	57·8	38·5	19·2	00
13	229	208	187·2	161·2	146	125·0	104·0	83·0	62·5	41·5	20·8	00
14	247	224	201·6	173·6	157	135·0	112·0	89·0	67·1	44·8	22·5	00
15	264	240	216·0	186·0	168	144·0	120·0	96·0	72·0	48·0	24·0	00

TABLE IV.—Saving of Higher-efficiency Lamps over 3·5-w.p.c. Lamps in Cents per 1,000 Hours of Service of a 16-c.p. Lamp.

Rate per kw.-hour in cents.	2·5 w.p.c.	2·6 w.p.c.	2·7 w.p.c.	2·8 w.p.c.	2·9 w.p.c.	3·0 w.p.c.	3·1 w.p.c.	3·5 w.p.c.
1	16·5	14·5	13·0	11·0	9·5	8·0	6·5	00
2	32·5	29·0	26·0	22·0	19·0	16·0	12·8	00
3	48·5	43·5	38·6	33·5	29·0	24·0	19·1	00
4	64·5	58·0	51·6	44·5	38·5	32·0	25·6	00
5	80·5	72·5	64·0	56·0	48·0	40·0	32·0	00
6	96·5	87·0	77·0	67·0	57·5	48·0	38·5	00
7	112·0	101·0	90·0	78·1	67·0	56·0	44·8	00
8	128·0	115·5	102·5	89·6	77·0	64·0	51·1	00
9	144·0	130·0	115·0	100·5	86·5	72·0	57·6	00
10	160·0	144·0	128·0	111·5	96·0	80·0	64·0	00
11	176·0	159·0	141·0	123·0	105·5	88·0	70·5	00
12	192·0	173·0	154·0	134·0	115·0	96·0	77·0	00
13	208·0	187·5	166·0	145·0	125·0	104·0	83·0	00
14	224·0	202·0	179·0	157·0	134·5	112·0	89·8	00
15	240·0	216·0	192·0	168·0	144·0	120·0	96·0	00

TABLE VIII.—Total Cost of Light per 1,000 Hours' Service of 20-c.p. New Gem Filament Lamp (at various Inefficiencies) Including Cost of Lamp Renewals and Power at Various Rates Shown, Lamp Price 20 c. (lamp life as given by Table II), (Minimum costs are underlined and starred).

Lamp inefficiency in watts per candle.	Total watts per 20-c.p. lamp.	Lamp renewal costs per kw.-hour in cents.	Total cost of light (power and lamp renewals).										
			Cost at 1 c. per kw.-hour.	Cost at 2 c. per kw.-hour.	Cost at 3 c. per kw.-hour.	Cost at 4 c. per kw.-hour.	Cost at 5 c. per kw.-hour.	Cost at 6 c. per kw.-hour.	Cost at 7 c. per kw.-hour.	Cost at 8 c. per kw.-hour.	Cost at 9 c. per kw.-hour.	Cost at 10 c. per kw.-hour.	Cost at 12 c. per kw.-hour.
2·1	42	2·7	$1·55	$1·974	$2·39	$2·81	$3·23	$3·65	$4·07	$4·49	$4·91	$5·33	$6·17
2·2	44	1·95	1·29	1·74	2·18	2·61	3·06	3·50	3·94	4·38	4·92	5·26*	6·14*
2·3	46	1·43	1·11	1·58	2·04	2·50	2·96	3·42	3 88	4·34*	4·80*	5 26	6 18
2·4	48	1·06	0·99	1·47	1·95	2·43	2·91	3·39*	3·87*	4·35	4·83	5·31	6·27
2·5	50	0·8	0·90	1·40	1·90	2·40	2·90*	3·40	3·90	4·40	4·90	5·40	6·40
2·6	52	0·614	0·83	1·36	1·88	2·40*	2 92	3·44	3·96	4·48	5·00	5·52	6·56
2·7	54	0·469	0·79	1·33	1·87*	2·41	2·95	3·49	4·03	4·57	5·12	5·66	6·74
2·8	56	0·37	0·76	1·32*	1·88	2·44	3·01	3·56	4·13	4·68	5·24	5·81	6·93
2·9	58	0·29	0·74	1·33	1·91	2·49	3·07	3·65	4·23	4·81	5·39	5·97	7·13
3·0	60	0·23	0·73	1·34	1·94	2·53	3·14	3·74	4·34	4·94	5·54	6·14	7·34
3·1	62	0·183	0·73*	1·35	1·97	2·59	3·21	3·83	4·45	5·07	5·69	6·31	7·55

TABLE X.—Comparison Values of New Higher-Efficiency Lamps and Present Lamps.

Lamps compared.	Useful life of lamp in hours.	First cost of lamp in cents.	Kilowatts per lamp.	Lamp-hours per kw.-hour.	Candle-hours per kw.-hour.	Cost of 1,000 candle-hours of light at 10 c. per kw.-hour.	Lamp renewal costs per 1,000 candle-hours.	Total cost per 1,000 c.p.-hours.
Gem filament, 40-watt lamp, 16-c.p., 2·5-w.p.c....	500	20	0·04	25·0	400·0	25 c.	2·5 c.	27·5
Ordinary carbon filament, 50-watt lamp, 16-c.p., 3·1-w.p.c.	500	16	0·05	20·0	320·0	31 c.	2·0 c.	33·0
Gem filament, 50-watt lamp, 20-c.p., 2·5-w.p.c....	500	20	0·05	20·0	400·0	25 c.	2·0 c.	27·0
Gem filament, 45-watt lamp, 16-c.p., 2·8-w.p.c....	1,000	20	0·045	22·2	355·5	28 c.	1·25 c.	29·25
Ordinary carbon filament, 56-watt lamp, 16-c.p., 3·5-w.p.c.	1,000	16	0·056	17·84	285·4	35 c.	1·0 c.	36·0
Tantalum filament, 50-watt lamp, 25-c.p., 2·0-w.p.c....	800	60	0·05	20·0	500·0	20 c.	3·0 c.	23·0

the paper as being the time in hours taken by the lamps to drop to 80 per cent. of their initial candle-power.

Table No. III, also taken directly from the paper, shows the saving to be effected by substituting the new Gem lamps of various inefficiencies for the ordinary 3·1-watt lamps, for various rates of charge per unit.

Table No. IV shows the saving to be effected by substituting the new Gem lamps working at various efficiencies, for the ordinary lamps taking 3·5 watts per candle-power and with various rates of charge per unit.

Table No. VIII shows the cost per 1,000 hours' service of running the new 20-c.p. Gem lamp at various efficiencies and with various rates of charge per unit. From this table can be seen at a glance the best efficiency to adopt for any particular rate per unit.

Table No. X is interesting, as it includes tantalum lamps. It shows the total cost per 1,000 candle-hours, energy being taken at 10 cents per unit, for 3·1 and 3·5-watt ordinary lamps, 2·5 and 2·8-watt Gem lamps and 2-watt tantalum lamps. This table is not taken directly from the paper, but has been slightly modified. It is to be noted that at 10 cents per unit the tantalum lamp is decidedly the cheapest of the series. As, however, the cost of renewals forms a larger proportion of the total cost, the comparison will be less favourable to the tantalum lamp when the charge per unit is lower than 10 cents.

For example, at a charge of 5 cents per unit, the costs would work out as follows:—

Cost in Cents per 1,000-c.p.-hours.

	Energy.	Renewals.	Total.
Gem, 20-c.p. 2·5-watt	12·5	2·0	14·5
Ordinary, 3·1-watt	15·5	2·0	17·5
Ordinary, 3·5-watt	17·5	1·25	18·75
Tantalum, 2·0-watt	10·0	3·0	13·0

SUGGESTIONS BY WORKMEN.

By W. O. HORSNAILL, A.M.I.Mech.E., A.M.I.E.E.

The system of inviting suggestions from employés for improvements in methods of manufacture, or in the design of the finished product, must now be familiar to many employers; but, so far, few attempts have been made to install such a system in this country. In the United States, however, several large manufacturing concerns make payments, or give prizes, for useful suggestions which are considered good enough to adopt, and the plan is stated to be very successful both as regards employers and workmen. This matter is now attracting the attention of those in control of engineering works in this country; therefore, some principles to be observed in carrying out such a system will be of interest at the present time. A belief still appears to obtain amongst many employers that it is the duty of their workmen to offer any suggestions which occur to them without any hope of reward, and this attitude must be disposed of before any successful method of obtaining ideas in this manner can be adopted. Some 50 years ago the relations between manufacturers and their employés were of a very different nature to those now existing. In the old times a man would enter the service of a master, expecting to pass and end his days without any further change, and the employer on his part would retain the services of old workmen long after they had become incapable of earning their wages, and would finally pension them off when they were too infirm to do any useful work. Under such conditions as these the better class of workman was willing to do something towards the advancement of his employer in what would now be considered his own time, and he might have been fairly asked to suggest improvements without any offer of payment.

In modern engineering works the above procedure has entirely disappeared, and for a young man to remain permanently with the undertaking in which he has received his training is considered to show a lack of enterprise, and would probably handicap his future prospects, as the best experience cannot now be gained by remaining in any one factory or works.

The above considerations lead to the conclusion that the relations between employer and workman, are now completely of a business nature, and the advent of old age pensions, and the State-aided provision of work for the unemployed, will eventually deal the death blow to any sentiment which may have struggled on through the competition of recent years, as with such provision for the destitute, employers will have no compunction in turning their men adrift whenever it suits their purpose to do so. The present position, therefore, may be laid down as follows:—The workman is engaged to do certain work during a definite number of hours in each week, with the full knowledge that during periods of slackness or from other causes, his services may be dispensed with at short notice. Under these conditions he cannot fairly be expected to do extra work excepting for additional pay. When the arrangement between master and men is regarded in this light, it is obvious that if the latter are asked to suggest improvements for the benefit of the former, they should be offered payment in some form or another for doing this work which is no part of their regular duties. It may even be stated that to invite suggestions without any offer of adequate payment for those adopted, does positive harm.

Take the case, for instance, of a man who has suggested an improvement which enabled certain articles to be produced for 60 per cent. of their previous cost, thus obtaining large profits for his employers. No doubt, at first, he will be flattered by the attention which his invention has attracted, but as time goes on, unless his position or wages are advanced, he will be permeated by a sense of injustice which will be freely imparted to his comrades. It would often be impossible or impolitic to advance such a man's position or wages, and if a number of men employed in a works, whose ideas had been adopted, were to take a similar view, the result would be a general feeling of suspicion which would injure the relations between the workmen and the management for many years.

Having decided that rewards or payments are just and essential, it becomes necessary to consider in what form, and to what extent, they should be made. The National Cash Register Co., Dayton, U.S.A., in whose works a successful suggestion system has been in force for about two years, have chosen the plan of making a small payment for every

idea offered immediately its adoption has been decided upon, followed by a competition for a certain number of quarterly prizes, the initial payment being one dollar and the prizes ranging from 50 down to 10 dollars. It is doubtful whether this scheme of payments can be improved upon, provided that a sufficient number of prizes be given to cover at least 50 per cent. of the competitors, so that each of the latter would have an even chance of obtaining something more than the initial payment for his invention. The immediate cash payment is, undoubtedly, a good feature, and one which will appeal especially to men in receipt of weekly wages.

In this country a somewhat similar method of obtaining suggestions from workmen was adopted a few years since by Messrs. G. & J. Weir, Ltd., of Glasgow, a certain sum being set aside every month by the firm to be paid away in prizes to the men who put forward the most useful ideas. The latter are judged by what is known as the "Friction Club," which is composed of all the heads of departments and the various shop foremen, meetings being held once a month for this and other purposes. The names of the suggesters are not known to the meeting, but only to an executive committee of five. Suggestions for this monthly competition are deposited in a box fixed in the gate house, which is cleared every day by the secretary, who dates each communication to allow of their consideration in order of priority. The above scheme is still in operation, and the results have been eminently satisfactory.

Theoretically, the giving of a prize is rather too closely allied to the granting of a favour and a payment in the form of a percentage on the saving effected by the invention during a certain period would be a fairer arrangement if it could be carried out, but several difficulties would arise in doing this. Disputes might occur as to the number of articles made with the help of a new device during the period decided upon, and payments would be deferred for a longer time than under the prize system, also a workman who made an improvement when trade was slack would not benefit nearly so much as another whose idea was adopted during a period of prosperity.

Taking these considerations into account, the method of making payments through the medium of prizes, appears to be the only one available, and as far as the writer is aware, no other has yet been tried.

The examination of the suggestions and the awarding of prizes will require very careful and conscientious handling, if the confidence of the men is to be maintained, and without the latter no suggestion system will be successful for any length of time. The matter is, however, purely one for the management to settle. There is no reason why the men should be represented on the committee appointed for this purpose, the position between the parties being that of buyer and seller—that is to say, the workman agrees to surrender his idea for a certain payment from the employer; but it is most important that he should be able to rely upon obtaining fair treatment; it is also desirable, if suggestions are refused, that reasons should be given for so doing.

The committee above mentioned may very well consist of three members, and the most suitable officials for this purpose are the works manager, the chief draughtsman and the shop manager. The competitor will naturally be called in to explain his invention, and it will often be necessary to obtain expert opinion from one or other of the foremen.

Conspicuous notices should be posted in the works, giving full details of the payments and prizes offered, and suggestions should be addressed to the works manager through the post. The method of placing locked boxes in the works is not altogether satisfactory, as many workmen do not care to allow their efforts in this direction to be known to their comrades or foremen until success has been assured.

In settling the amount to be given in prizes, the type of product manufactured must be taken into account; where articles are made of a special nature, and of which the design is fully protected by patents, an improvement reducing the cost of manufacture or enhancing the selling value is of much greater worth than would obtain if open competition were encountered. In the latter case the device adopted would very soon become known and taken up by trade competitors, resulting in a reduction of prices; or equally good methods may be discovered by outside firms, thus having a similar effect, therefore unless an idea is good enough to patent, the advantages accruing from it are not likely to remain in force for any considerable period.

In conclusion, it may be stated that a suggestion system, if properly worked, can be made to pay handsomely, and should keep the undertaking adopting it ahead of its competitors, unless they have followed a similar course.

BUSINESS NOTES.

"Everbryte" Reflector.—We recently mentioned the aluminium reflector called by the above title, for ordinary carbon lamps; this has been adapted also to lamps with metallised carbon filaments, and now to the tantalum lamp. The accompanying figure shows the last-named combination; the reflector is not

"Everbryte" Reflector on Tantalum Lamp.

screwed on, but fits on the collar of the lamp. Tests made by the Westminster Electrical Testing Laboratory on August 23rd last, with a 105-volt tantalum lamp giving 18·6 c.p. mean horizontal and 4·35 c.p. vertical without reflector, and taking 38·6 watts, or 2·07 watts per mean horizontal candle and 9·10 watts per vertical candle, showed that the reflector increased the vertical candle-power to 37·6 c.p., taking 1·025 watts per candle in the vertical direction. The maximum intensity, we are told, is found at an angle intermediate between horizontal and vertical. The patentee is Mr. E. Chamberlain, of 35, Claremont Street, Islington; the agent for the trade is Mr. J. S. Cunnington, of 93, St. Martin's Lane, W.C.

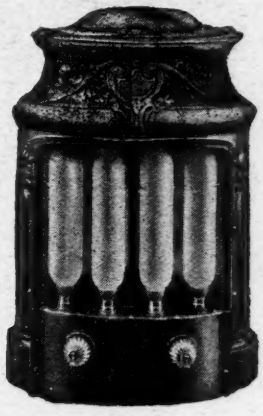
The Russian Westinghouse Co.—The recent purchase by Westinghouse interests of the undertaking of a Belgian electrical company in Russia, to which reference was made in a previous issue, has now been followed by the formation in Paris of the Société d'Electricité Westinghouse de Russie, which is apparently intended to further the enterprises associated with this name, and to deal with the tramway contract recently obtained for St. Petersburg. As founders of the new company are cited the Société Anonyme Westinghouse of St. Petersburg, the Westinghouse Electric Co. of London, the Westinghouse Machine Co. of Pittsburg and the Compagnie Centrale d'Electricité of Liége, Belgium. The share capital amounts to £800,000, divided into 80,000 shares of £10, of which 52,000 shares have been allotted to the founders, while the remainder has been subscribed and paid up to the extent of 25 per cent. The directors are M. Ernest Dejardin-Verkinder, the Marquis de Frondeville and M. T. Lombardo, of Paris; Mr. J. H. Lukach, of London; Mr. E. Smith-William, of St. Petersburg; and Mr. G. Westinghouse, of Pittsburg.

Bankruptcy Proceedings.—J. M. Vaughan, electrical engineer, Three Queens Lane, Bristol.—The *London Gazette* notifies that a first and final dividend of 8d. in the £ is payable on September 12th by the Official Receiver, 26, Baldwin Street, Bristol.

H. Jones & Co., electrical engineers, Longton.—The examination of W. J. Charlesworth and H. Jones took place at Stoke-on-Trent on August 28th. The partnership accounts show liabilities amounting to £116, and assets nil. The examination was adjourned, Jones being ordered to prepare an account explaining how his deficiency had arisen.

Plant for Sale.—The Rhyl U.D.C. is inviting offers for the purchase of a 165-kw. steam dynamo now in use. See our advertisement pages to-day.

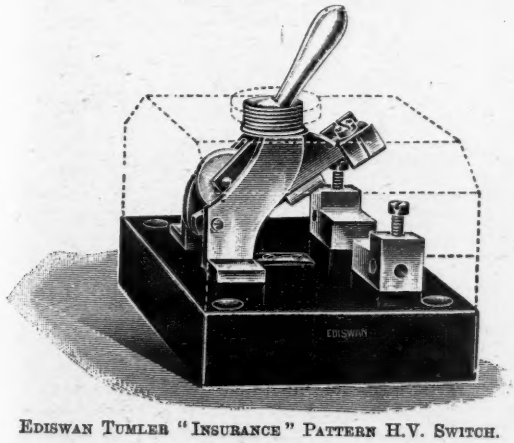
Carron Radiator.—The accompanying illustration shows a new design of electric radiator which is being introduced by the Carron Co., of Carron, Stirlingshire, N.B. The radiator is styled "No. 1," and has an ornamental cast-iron front and top,



Carron Radiator.

four electric lamps in two circuits, each separately controlled, and a polished copper reflector, together with flexible cable and plug; it measures 18 in. wide × 25½ in. high, and consumes ·53 or 1·06 units per hour, according to the number of lamps in use.

Ediswan Accessories.—The Edison and Swan United Electric Light Co., Ltd., have issued a new catalogue (Section 3) relating to their electric lighting accessories, switches, switchboards, and wiremen's sundries. It is the most complete catalogue of accessories the company have yet issued; a great number of novelties have been introduced, and obsolete goods have been eliminated. It consists of over 100 pages, all of which are fully illustrated. Special attention may be directed to the new button type wall and floor sockets, with "S" insides, and also to the new



Ediswan Tumler "Insurance" Pattern H.V. Switch.

patterns of flush switch covers. The wedge Tumler switch is now made with independent break, and is listed in a variety of combinations, such as tandem, &c. The "Economic" boards in iron cases are claimed to be a great advance in distribution systems. Other features are the "Safety" Tumler switch (an improved pattern with independent break), wind-up ceiling roses, square base wedge switch, press-button switches with square base, push-button keyholder, and the factory wedge switch. The Tumler "Insurance" pattern h.v. switch is shown in the accompanying figure. There is a complete alphabetical and numerical index to the catalogue.

Circulating Library of Scientific Works.—As the result of the letter which appeared in our "Correspondence" columns on this subject last week, we have received from Mr. H. K. Lewis, of 136, Gower Street, London, W.C., a prospectus of his circulating library and a list of the new books and new editions added during April, May and June last. Amongst the latter we notice a fair number of important engineering books of recent issue, but in the absence of a complete catalogue of the library, we are unable to estimate the completeness or otherwise of the collection. The prospectus states that all branches of engineering science are covered, and every book of importance which is asked for is at once purchased. The library was established over half a century ago for the medical profession, and has gradually extended its scope. The catalogue embraces 9,000 titles of works, and over 13,000 volumes are in the library or in circulation. The terms range upwards from one guinea per annum for one volume at a time; subscribers pay carriage both ways.

Catalogues and Lists.—Messrs. Bruce Peebles and Co., Ltd., 1, London Wall Buildings, E.C.—Pamphlet No. 17, relating to continuous current motors, and describing standard protected machines up to 125 h.p. The pamphlet is exceptionally well illustrated and conveniently arranged, and prices are given, with dimensions and efficiencies.

Messrs. James Gordon & Co., 81-83, Knightrider Street, E.C.—Pamphlet "M," describing, with illustrations, Ferguson's patent sectional superheaters.

Messrs. Johnson & Phillips, Ltd., Charlton S.O., Kent.—Price list D of alternating current transformers, single and three-phase, air and oil-cooled, designed for high efficiency and good ventilation.

Messrs. Simplex Conduits, Ltd., Garrison Lane, Birmingham.—Leaflet No. 162, dealing with an entirely new type of lampholder, for use in damp situations; a new ceiling rose for mill and factory lighting, mounted direct on the iron box; and a new wall fastener, which dispenses with the use of plugs.

The Carron Co., Carron, Stirlingshire.—Leaflet illustrating the "Carron" electric radiators, No. 1 type, a neat pattern fitted with four lamps.

Messrs. Mavor & Coulson, Ltd., Glasgow.—The September date-card makes an offer to users of the Pick-Quick coal-cutters concerning the price of, and carriage on, spares and renewal parts.

Book Notices.—Messrs. Whittaker will publish shortly a new book entitled "Elementary Principles of Continuous-Current Dynamo Design," by H. M. Hobart, M.I.E.E. A novel feature in this book will be a number of complete designs of machines in tabulated form and tables giving the data of these machines. The book also will be fully illustrated.

"Journal of the Institution of Electrical Engineers," Vol. 37, No. 179, August, 1906. London: E. and F. N. Spon, Ltd. 5s.

"Proceedings of the American Society of Civil Engineers," Vol. XXXII., No. 6, August, 1906. New York: The Society, 220, West 57th Street.

"Die Verwendung von Mikrophonkontakten für telegraphische Relais und zum Nachweis schwacher Ströme." By Chr. Jensen and H. Sieveking. Excerpt from *Annalen der Physik*. Leipzig: J. A. Barth.

"Anwendung des Mikrophonprinzips." By Chr. Jensen and H. Sieveking. From the year-book of the Hamburgischen Wissenschaftlichen Anstalten, No. 23, 1905. Hamburg: Lucas Gräfe and Sillem.

"Bulletin of the Bureau of Standards," Vol. 2, No. 1, June, 1906. Washington: Government Printing Office.

Engineering Standards Committee's Reports on "British Standard Nuts, Bolt-Heads and Spanners," and "British Standard Specification for Steel Conduits for Electrical Wiring," Nos. 28 and 31 respectively. London: Crosby Lockwood & Son, or the Committee. 2s. 6d. net each.

"Electric Bells, Indicators and Aerial Lines." By Umberto Zeda; translated by S. R. Bottone. London: Guilbert Pitman. 2s. net.

Dissolutions and Liquidations.—Premier Electric Lamp Co., Ltd.—A petition for confirming the reduction of capital from £100,000 to £35,631, is to be heard at the Liverpool District Court on September 25th.

Messrs. J. W. Waring & Co., electrical engineers and contractors, Regent Street, Rugby.—Messrs. J. W. Waring and S. P. Marsh have dissolved partnership. Mr. Marsh will continue the business under the same style, and will attend to debts.

The Swindon Motor Engineering Co. (formerly Swindon Electrical Engineering Co.), electrical engineers, Swindon.—Messrs. E. Thornton and J. C. Crowdy have dissolved partnership. Mr. Crowdy attends to debts, and will continue the business.

Messrs. Deutchberger & Wells (the Electro-Mechanical Engineering Works), Hackney Road, London.—Messrs. F. H. Wells and N. Deutchberger have dissolved partnership. Debts will be paid by Mr. Deutchberger, who will continue the business.

Messrs. Morris & Morris, opticians and electricians, Leigh, Lancashire.—Messrs. H. M., G., and T. Morris have dissolved partnership. Messrs. H. M. and G. Morris will attend to debts, and continue the business.

Pioneer Electric Light and Power Co., of China, Ltd.—A meeting of this company is to be held at 35, New Broad Street, E.C., on October 2nd, to hear an account of the winding-up from the liquidator, Mr. R. W. Blackburn.

Sun Fan Co., Ltd. (in voluntary liquidation).—The receiver and liquidator, Mr. J. Butterfield, has announced that the plant, stock in trade, and book debts, have realised (net) less than £1,500. The first, second and third series of debentures, with interest, amount to £4,000. The first debenture-holders have been paid in full, the second ditto. receive 1s. to 2s. in the £, and the third get nothing. The ordinary creditors and shareholders, therefore, receive no dividend.

Nernst Lighting.—We understand that a large number of corporations and electric supply companies have lately taken up the maintenance of Nernst lamps, in order to make sure that their consumers get the best value for their money, and also in order to prevent those who grumble at their energy bills from falling into the hands of the gas companies. Amongst the towns that have adopted the maintenance scheme of the A.E.G. English Manufacturing Co., Ltd., for Nernst lamps are Tynemouth, Northampton, Newcastle-on-Tyne, Huddersfield, Norwich, Aston Manor, Loughborough, West Bromwich, Nuneaton, Wrexham, Hereford and Ipswich. The last-named town is just sending out a circular to all its consumers, fully explaining the maintenance proposal and the necessity for using efficient lamps in order to reduce bills.

Italy.—The British Consul at Leghorn reports that a large and important company has just been formed by a few well-known Genoese and Livornese capitalists for the manufacture of insulating wires of all dimensions, and electrical appliances. The works will be situated at Torreta, the suburb near the station where so many other manufactories are rising. The initial capital of the company is 1,200,000 lire, but this can be increased to 3,000,000 lire by the simple vote of the directors. The works will employ about 300 operatives, and it is estimated that their annual output will be about 3,000,000 lire. The company was started under the auspices of the Banca Commerciale Italiana, which is becoming more and more a power in the industrial development of the country.

Trade Announcements.—Mr. H. N. Blake, of 28, High Street, Birmingham, has recently been appointed agent for Birmingham and district by the Gilbert Arc Lamp Co., Chingford, Essex, and Messrs. E. Goossens, Pope & Co., and the Pope Electric Lamp Co., for the sale of their respective goods.

The Crypto Electrical Co. has altered its address to 155 and 157, Bermondsey Street, London, S.E.

Steam Turbines for Sydney, Australia.—The municipality of Sydney has decided to install steam turbine generating sets in its electricity works, and after deputing its chief engineer, Mr. T. Rooke, to make a tour of inspection of the various types of turbines installed in different parts of the world, has decided to adopt the Willans-Parsons type, as built by Messrs. Willans & Robinson, Ltd., of Rugby.

LIGHTING and POWER NOTES.

Aberdeen.—The city electrical engineer has recommended reduced charges for energy as follows: Private lighting, 5½d. and 1½d. per unit, maximum demand system, in place of 6d. and 2d. respectively; public lighting, 5½d. and 1½d., in place of 6d. and 1½d.; heating and motors, 2½d. and 1d. in place of 3d. and 1d. These alterations will reduce the revenue on the present output by £3,328.

Bath.—A L.G.B. inquiry was held on August 31st into the application of the T.C. for a loan of £4,000 for extensions of mains. There was no opposition.

The T.C. has been approached by Messrs. Stothert & Pitt for a supply of energy for power purposes, and it appears that the firm will take a minimum consumption of about 140,400 units per annum, the Council agreeing to charge 1½d. per unit, with discounts. There is evidence that other power consumers will come on when the new mains are laid down. Bath at the present time has a very small day load, so that these prospective power consumers should be welcome. The Corporation has a severe competitor in the Gas Co., the price being as low as 2s. per 1,000 cb. ft.

Blackburn.—An electric cable fused at Blackburn late on Saturday night, resulting in two simultaneous explosions. The lids of two manholes were blown off, and the principal thoroughfare was left in darkness for the remainder of the evening.

Canada.—Goderich, Ont.—A proposition by the Maitland River Power Co. to develop power from the Maitland River by the erection of a huge dam near Goderich, the capital cost of the undertaking to be at least $300,000, and to supply energy to the town for municipal purposes at a fixed sum for 30 years, as well as affording cheap power for industrial purposes, was recently put to vote and approved of by a large majority. The Maitland River Power Co. in their negotiations stipulated that the town should guarantee the company's bonds to the extent of $150,000, and the T.C. passed the necessary by-law. The Mayor, however, who was opposed to the proposition, refused to sign the bonds, and legal proceedings have been taken to compel his worship to carry out the duties of his office. In consequence, the Mayor has resigned. He is to be asked to reconsider his decision.

Chatham.—During recent years there has been a marked development in the electrical department of Chatham Dockyard, and in a few weeks' time a power station, the building for which is erected, will be in full working order. The new station will supply energy for power and lighting purposes not only in the yard, but also in the R.N. Barracks, the Ordnance Gun Wharf, and other establishments. The task of organising the new department has fallen upon Mr. L. Newitt, electrical engineer under the Admiralty, with whom is now associated Mr. Fletcher, first assistant electrical engineer, who will have charge of the new power station.

Chepstow.—The B.G. has received from the L.G.B. sanction to install the electric light at the workhouse.

Chile.—The British Consul at Valparaiso, in a recent report, states that the Electric Light and Traction Co. (a German concern) has now completed its generating station at Sauces, and all electric power is now obtained from the company.

Continental Notes.—Germany.—A scheme is being promoted in Germany for the establishment of an extensive station for the supply of power to a large portion of German Lorraine, the district of the Saar and a part of the Palatinate. The principal promoters are the Saar and Moselle Mining Co., of Karlingen (Lorraine), the Berlin Company for Electrical Enterprises and the Dresdner Bank. At present the mining company has a large plant in operation, and extensions would enable a very wide area to be supplied. It is proposed to furnish large consumers with power at the rate of ·72d. to ·9d. per kw.-hour, or a charge of one-fourth the price prevailing in the Saar coal region at the present time for power purposes, and of one-eighth the rate for lighting requirements.

A supplementary session of the Bavarian Parliament is to be held in January to dispose finally of the State Bill for the Nationalisation of the Water Power in that part of Germany, the measure having already passed through the Second Chamber rapidly and without due consideration being given to the position of industries. It is officially estimated that the available water power which could be utilised for State purposes amounts to 300,000 h.p. The Government Bill proposes to control this power, and in so far as it might not be required, it is stated, for the needs of the military department, it would be used in connection with the working of the State railways by electricity, while the balance would be available for industrial purposes. As passed by the Second Chamber, the Bill will place restrictions upon private enterprise in the future where the question of water power is concerned, as those who wish to erect works will have to pay a certain tax to the State for water power, the withdrawal of water from the rivers or the discharge of liquids into them, and the amount of the tax will be fixed in each individual case. Existing factories or works will be exempt from the tax so long as they are not enlarged. The Bill has been passed provisionally without there being any immediate prospect of the conversion of the State railways to electric traction, notwithstanding the publication of reports to the contrary in recent months, and also in the face of large private schemes for the industrial utilisation of water power. Only one need be mentioned, and that is the proposal of the Baden Aniline and Soda Works Co., to expend £1,500,000 for the erection of works to use 20,000 h.p. for the extraction of nitrogen from the atmosphere for manurial and explosive purposes, but the scheme has so far failed to secure the approval of the Government.

The municipal authorities of Stendal, Saxony, are about to invite tenders for the establishment of an E.L. station in the town.

Italy.—The authorities of the province of Como have granted a concession for a plant to be put down to utilise the water-power of the rivers Era-Maria and Ura in the generation of electrical energy for lighting and power purposes.

Switzerland.—The total output of the electric generating stations in Switzerland at the present time comes to about 600,000 h.p. Of this quantity about 13 per cent. is used for railway working, 40 per cent. for lighting, 23 per cent. for electrolytic works and 24 per cent. for supplying power for industrial purposes. Notwithstanding this, the amount of coal annually imported has a value of nearly £3,000,000 sterling.

There is some talk at present of a large power transmission project at Sackingen on the Reno, where it will be possible to utilise 200,000 h.p.

Dover.—The T.C. has applied for a loan of £7,500 for E.L. purposes.

Eccles. — The Corporation Electricity Committee has recommended that from April 1st next a flat rate of 4d. per unit shall be charged for energy supplied to offices, shops, dwelling houses, public houses and clubs for lighting purposes.

A loan of £15,078 for E.L. purposes is to be applied for.

Ecuador.—H.M. Consul at Guayaquil reports that a decree providing for the encouragement of manufacturing and agricultural industries in Ecuador has been issued. The decree concedes the free use of the streams, waterfalls and all natural waterways to all who may start in the country new factories employing hydraulic or electric power.—*Board of Trade Journal.*

Finchley.—The revenue of the U.D.C. electricity undertaking for the year ended March 31st last amounted to £7,261; £5,200 from sale of energy, £1,796 from public lighting, and £265 from meter rents. Working expenses, including management charges, &c., amounted to £4,407, leaving a gross profit of £2,854, and after providing a sum of £2,747 to meet financial charges, a net profit of £107 was realised.

Hastings.—An explosion in a street chamber, recently, which resulted in a child being fatally injured by a falling cover, formed the subject of a Coroner's inquest on the 29th ult. From the evidence it appears that a fractured gas pipe in the vicinity of an adjoining chamber, and the presence of a lighted match which dropped through the ventilating hole in the cover, account for the explosion. No electrical apparatus was injured; a recommendation as to improved ventilating arrangements was made by the Coroner.

Londonderry.—The Corporation is considering a proposal by Messrs. J. G. White & Co. to take over the electrical undertaking. The firm suggests repaying to the Corporation all the outstanding capital expenditure; the matter is, however, adjourned pending the receipt of further details.

Loughborough.—The borough electrical engineer, Mr. W. H. Allen, has forwarded us a batch of leaflets and a "round robin" relating to the Corporation's lighting and power supply. The latter is very smart, and Mr. Allen is to be congratulated on

It is surprising what can be done for a penny. Round the card is set out what, for this modest sum, electricity will do. For example, it will clean 5,000 knives, cook 15 chops in 15 minutes or keep your feet warm for five hours. The Corporation will supply any consumer with an electrical fan at a cost of 7s. 6d. per quarter, without any further charge for energy, or in the cold weather a radiator at the same stated charge, plus 1d. a unit for energy consumed. The charges for energy in Loughborough are:—Private lighting, 4d. per unit; workshop and factory lighting, 3d.; power supply, 1d. Under a free-wiring scheme installations are put in free, but energy is charged for at 5d. per unit for private lighting and 4d. for factories and workshops, no meter rents being charged in this instance. A hire-purchase scheme is in operation for motors and arc lamps.

New Zealand.—Wellington.—A poll of ratepayers has resulted in sanction to the outlay of £100,000 for electric lighting works, £10,000 for additions to public lighting, £30,000 for power for lifts, machinery, &c., and £52,052 for tramway extension, additional cars, &c.

Ossett.—Consequent upon the refusal of the L.G.B. to sanction an E.L. loan as mentioned last week, the T.C. has, by the casting vote of the Mayor, disbanded the E.L. Committee, which was formed in 1905 with plenary powers to carry out the resolutions of the Council on electricity matters. In all, the attempt to secure an electricity supply has cost £700, half of which is for engineers' fees.

Preston.—A lighting scheme involving the use of 344 5-ampere street lamps, supplied from the tramways power station, also the lighting of some public buildings, is being considered by the T.C.

Salford.—The Electricity Committee has decided to recommend the Council to make application to the L.G.B. for sanction to borrow £10,000 to cover the cost of the purchase of motors for hiring out, and £25,000 to cover extensions and services during the next two years.

South Africa.—Johannesburg.—The Rand Water Board has accepted the offer of the Rand Central Electric Works, Ltd., to supply electrical energy to the Board's pumping station at the Simmer and Jack Mine, on a two years' contract.

East London.—Mr. J. Mordey Lambe, the town electrical engineer, has returned to East London after an absence of several weeks inspecting the E.L. installations at Durban, Johannesburg, Pretoria, Kimberley, &c. Information has been sought to serve as a guide in connection with the new plant for East London.

An attack having been made on Mr. Lambe, in his absence, by certain members of the T.C., the local *Dispatch* took up the cudgels on his behalf, and reminded his assailants that Mr. Lambe's absence was due to the fact that he was getting expert advice and assistance before finally reporting on the reorganisation of the electrical scheme.

South Shields.—The following brief statement shows the result of the working of the Corporation E.L. undertaking for the past two years:—

Year ended March 31st,	1906.		1905.
Total revenue	£17,331		£18,132
Total working costs (including public lighting)	7,211		6,936
Gross profit	10,120		11,196
Cranage dues (Holborn Quay) profit	182	deficit	78
Interest	4,770		4,899
Sinking fund	4,494		4,231
Net profit	1,038		1,988
Capital expended	£163,047		£151,838
No. of 8-c.p. lamps	62,927		59,209
Average price obtained:—			
Private supply	3·47d.		3·88d.
Public lighting	1·61d.		1·61d.
Total	2·80d.		3·06d.
Working costs (including public lighting) per unit	1·22d.		1·20d.
Maximum load	970 kw.		953 kw.
Units sold:—			
Private supply	919,182		879,227
Public lighting	519,739		506,166
Total	1,438,921		1,385,393

The reduction in revenue is accounted for by the fact that during the year ended March last, reduced charges for supply have been in operation, *i.e.*:—7d. and 1½d., or 4d. per unit, instead of 7d. and 2d., or 5d. per unit. At the end of the past twelve months new plant was installed as follows:—One marine boiler by Messrs. J. T. Eltringham & Co., of South Shields; two 550-kw. McLaren-Dick, Kerr traction generators, a B.T.-H. switchboard and auxiliary plant by Messrs. J. Abbot & Co., of Gateshead. The number of public arc lamps at March was 93, and the number of gas standards converted into electric for public lighting was 461. Mr. J. H. Cawthra, the borough electrical engineer, pointed out that the reserve fund stood at a very low figure (£4,133), and he recommended that the balance on the past year's working should be placed to this account.

Surbiton.—The U.D.C. at its next meeting is to consider a recommendation of the Parliamentary Committee that power be sought to borrow a further £20,000 for the development of the E.L. undertaking. The Council in 1902 entered into a contract with Callender's Cable and Construction Co., whereby the Council supplied the site and buildings, whilst the company provided the plant, &c.

Widnes.—Messrs. Crompton & Co. have informed the T.C. that they intend applying for a prov. order for E.L.

Worthing.—The Electricity Committee of the T.C. has recommended the application for a loan of £1,000 for house services and meters; £500 for distributing mains extensions; and £160 for a water softening apparatus.

Ystradgynlais (Brecknockshire).—A local E.L. Co. has been formed to supply energy to the district.

TRAMWAY and RAILWAY NOTES.

Australia.—Essendon-Flemington (V.).—The electric tramways are approaching completion. The track is double, with centre poles, and the rolling stock consists of 15 motor-cars and 10 trailers, built by Messrs. Brill & Co. The power station contains three water-tube boilers, and three generators of 750-kw. total output, driven by Browett-Lindley engines.—*Electrical Record.*

Canada.—Montreal.—A new power house for the Street Railway Co. is now under construction. The building will be of steel frame construction, and 288 ft. long × 150 ft. wide. The plant equipment consists of five 3,000-h.p. vertical cross compound engines direct-connected to five 2,000-kw. generators and two 1,500-h.p. engines of the same type, direct connected to two 1,000-kw. generators. The ultimate boiler capacity will be 13,000 h.p., and will be equipped with chain grates, superheaters, economisers, &c. The engines will be equipped with barometric condensers. A complete equipment of coal and ash handling machinery is also to be installed.—*Canadian Electrical News.*

Continental Notes.—Germany.—After experiments extending over the last four years, the interested Government departments in Prussia are about to investigate the financial side of the gigantic project for the conversion to electric traction of the Berlin city and suburban State railways. Indeed, the capital question is regarded as the more important of the two problems concerned, especially as no less than £9,000,000 is probably involved for the transformation of the city railway alone—a sum which would play a prominent part in the Budget of the Prussian State. The result of the inquiry will determine the action of the Minister of Finance, whose attitude in the matter is entirely unknown, and the fact that the present stage has been reached is attributed to Herr Breitenbach, the new Minister for Railways. It is understood, from the general outlines which have already been set forth, that, in the event of the scheme being approved, the single-phase alternating current system will be adopted, as the method which has so far yielded the best results from the experiments made in Germany. The operation of the city and suburban railways by electricity would necessitate the provision of plant of from 150,000 h.p. to 180,000 h.p., which would be supplied from three generating stations. If electrical working were continued on both the old tracks, it would be possible to increase the service by about 27 per cent., but this would not permanently meet the circumstances of the case, and the construction of a second-storey track—a track immediately over the existing lines—is being kept in view, especially as it would advance the carrying capacity by 150 per cent. It is calculated that the whole of the city railway could be converted to electric traction by the year 1915 and the suburban lines by 1920.

Italy.—A Decree authorising the Milan Municipality to construct and work an electric tramway between the Piazza del Duomo and the Piazza del Ippodromo di San Siro has been granted.—*Board of Trade Journal.*

Glasgow.—The receipts of the Corporation tramways on Saturday last amounted to £4,313 9s. 11d., thus constituting a record day's takings.

Halifax.—A serious state of affairs exists at Halifax, arising out of a dispute between the Corporation and its tramway employés. On Thursday last week the men determined to strike unless certain demands which they made—including the reinstatement of the driver Chadwick, who had lost his position on account of the overturning of his car on July 1st—were complied with. When their notices were handed in the Tramway Committee immediately set about finding a new staff. The notices would have expired on Saturday last, but on Friday the men disregarded a request to appear in plain clothes, and they were locked out. On Friday the tramway service was suspended; on Saturday the service was only partial, and did not extend beyond 7.30 p.m. It was conducted by 80 men who had been brought in from other towns. On account of the excitement caused by the dispute the new comers were housed at the tram depôt. Some of the old hands returned to work, and were given police protection. Although much excitement existed in the working-class quarters of the town there was no serious disturbance of the peace. The strikers held a demonstration, which was attended by about 5,000 persons, on Sunday; and a resolution was passed protesting against the Tramway Committee importing men, without the consent of the Council, to work the cars, and calling upon the Council to stop the service or recall the men on strike.

A conference was held between the men's representatives and Tramway Committee last Friday, and proved abortive. The men offered to compromise on the demand for a re-employment of the

dismissed driver, and to withdraw their notices until the T.C. had an opportunity of considering the request for improved wages and conditions, providing that engagements entered into with outside men to take positions were cancelled.

The town clerk has received the report of Lieut.-Col. Druitt on his inquiry into the circumstances of the fatal tramway accident at Halifax on July 1st. Col. Druitt, in abstract, explains that the cause of the accident was due to the driver not appreciating the different effects of the brakes of the car when the rails were greasy and when they were dry. He considers that the car got out of control owing to motorman Chadwick not having the slipper-brake sufficiently applied when coming on to the steeper gradient after passing Beacon Hill Road, and not using sand until the speed was too high. The car was in perfect working order, and after the accident it was tried in Col. Druitt's presence down the steepest hill in Halifax on a grade of 1 in 9·6; the brakes worked perfectly on a wet rail, and they had not been touched in the meantime. The motorman stated that he tried the rheostatic brake and also reversing the motors, but neither operation had any effect on the speed of the car. In the report Chadwick is described as an experienced driver; he had been in the shops as a fitter for four years, and a motorman for 13 months.

Evidence showed that the car left the rails before actually overturning, and it is probable that the hind wheels left the rails first, as owing to the slipper-brake being hard on the weight would be thrown off the back part of the car. If the car had not left the rails it might have overturned by the action of centrifugal force alone. The gauge at Halifax is 3 ft. 6 in., and on the curve in question, theoretically, the critical speed would be about 30 m.p.h. With the standard gauge it would be about 35 m.p.h.

On the question of light railway gauges, Col. Druitt points out that there is little or no space gained in the roadway for other traffic by the use of the 3 ft. 6 in. gauge, as the cars generally used are 6 ft. 6 in. in width, and on a 4 ft. 8½ in. about 6 ft. 10 in. to 7 ft. The narrow gauge, continues the report, facilitates the construction of tramways under the Tramway Act by getting a 9 ft. 6 in. space between the inner rail and the kerb in narrow roads where the necessary clearance could not be got with a 4 ft. 8½ in. gauge, but owing to the superiority of the 4 ft. 8½ in. gauge it would be well to adopt it in future, especially on systems with steep gradients and curves at the bottom of gradients. For this short report we are indebted to the *Yorkshire Daily Observer*.

Knaresborough.—The Wakefield and District Light Railway Co. has written to the R.D.C. suggesting the construction of electric tramways between Harrogate and Knaresborough, *via* Oatlands, Little Wonder, Harlow Hill, Starbeck, and Scriven. The Council has referred the matter to a Committee, which will interview a representative of the company.

Liversedge.—The U.D.C. has asked the B. of T. not to grant the application of the Tramway Co. for a year's extension of time for completing the tramways to Cleckheaton.

London.—Baker Street-Waterloo Railway.—On the 1st inst. through bookings were introduced between the Baker Street and Waterloo and the L. and S.-W. Railways, in so far as about 50 L. and S.-W. suburban and local stations are concerned.

City and South London Railway.—The extension of the company's line from its present terminus at Islington to Euston Station will not, it is stated, be opened for traffic until January or February of next year. Originally it was hoped that the extension would be ready for use this autumn, but unexpected engineering difficulties have been encountered.

L.C.C.—A considerable number of summonses have lately been taken out against L.C.C. tramway drivers for exceeding the B. of T. speed limits, and while we are much against dangerous speeds, our sympathies in this case are entirely with the motormen concerned. With no certain means of telling the speed at a given point, and with no leisure in which to experiment with stop watches over measured miles, hedged in by sundry speed limits in divers places, and with his attention equally divided between safe driving and keeping schedule time, the life of the L.C.C. driver is evidently "not a happy one."

We might suggest speed limit notices by the roadside, similar to those adopted on our railways, as one way of jogging the driver's memory; these, with speed indicators on the cars, would at least give the driver a fair chance against the policeman and his stop-watch. While on the subject of police supervision, we wonder how the L.C.C. have managed to escape obstruction penalties at their various bridge termini?

Rochdale.—The tramway employés have lately made a demand for payment of time and a quarter for all overtime. This the Committee has declined.

Tasmania.—Launceston.—A Committee of the City Council has decided to recommend that a poll of the ratepayers be taken as to whether a tramway system for the city and suburbs should be carried out; and if so, whether a scheme should be carried out by the municipality or by a private company.

Tranent.—A special meeting of the T.C. has been held to consider the proposal of the National Electrical Construction Co., as to the proposed line from Tranent to Levenhall, at which place the Musselburgh lines terminate.

(Continued on page 384.)

GREAT NORTHERN AND CITY RAILWAY: NEW STEEL COACHES.

We recently had the pleasure of revisiting the Great Northern and City Electric Railway for the purpose of inspecting the new all-steel coaches, which have been built for the company by the Brush Electrical Engineering Co., Ltd., and equipped with motors, controllers, &c., of the British Thomson-Houston Co.'s make; the whole of the installation and arrangement of the electrical apparatus has been carried out by the Railway Co.'s staff, under the supervision of Mr. R. P. Brousson, the general manager and engineer. We have on previous occasions referred to the leading features of the Brush steel coaches, some of which were supplied to the Great Northern, Piccadilly and Brompton Railway, and described in our issue of September 22nd, 1905. The coaches made for the Great Northern and City Railway, however, differ in certain respects from the former. Owing to the large diameter of the tunnels, it has been possible to design the rolling stock on a more liberal scale than on the other "tube" railways, and this, with other improvements, has led to the result that the G.N. and City coaches are the most roomy, comfortable and easy-running in London. The new coaches, 18 in number, are similar in general arrangement to the older type, and, as the rivets are carefully concealed, there is no external reminder of the boiler-shop, such as disfigures the roughly-built American coaches on the Baker Street and Waterloo Railway. Wood is used but sparingly, and then only for ornamental purposes.

The whole of the framework is of steel; the underframe consists of two main longitudinal members of channel section, braced together with cross bearers and covered with a stiffening plate of sheet steel $\frac{3}{32}$ in. thick, which is riveted to the top flanges of the channels. The whole of the body of the coach is utilised in conjunction with the underframe to form a box girder, the junctions of the roof and sides being stiffened with longitudinal steel angle bars. The outer panels are of steel plate, $\frac{1}{8}$ in. thick, and the inside panels of aluminium, $\frac{1}{16}$ in. thick. The bolsters are of substantial box girder construction, with steel forgings at the middle to receive the king-pins of the bogies; the drawgear is so arranged that the whole of the buffing and hauling stresses are conveyed direct to the king-pin at this point, there being a central combined buffer and draw-bar. The bogie trucks are of the Brush standard type.

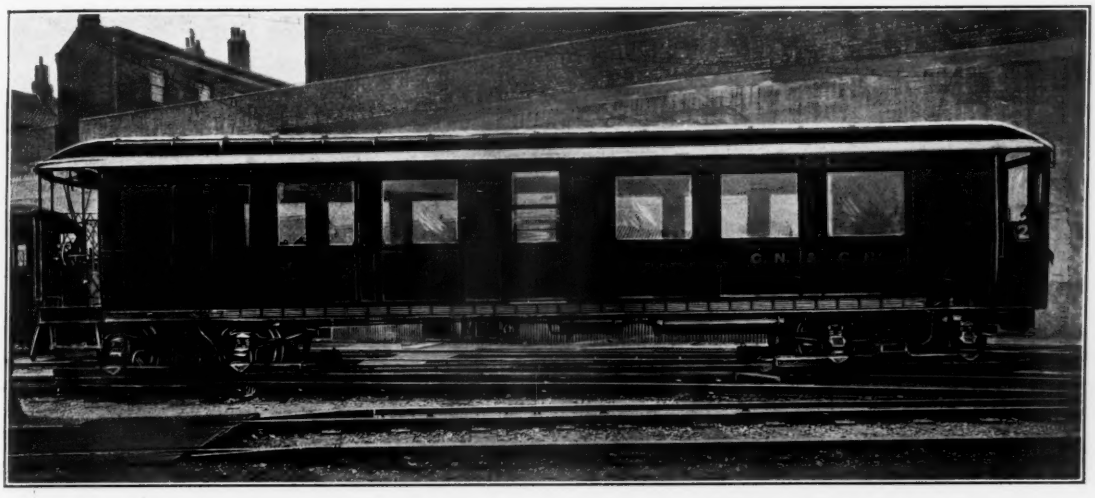
The main dimensions are as follows:—Length over body, 41 ft.; over platforms, 49 ft. 6 in. Extreme width, 9 ft. 4 in. Height from floor to roof, 8 ft. 5 in.; from rail to top, 12 ft. 4½ in. Wheel-base, 6 ft. 1 in. Bogie centres, 34 ft. 6 in. Diameter of wheels, 3 ft. Weight of body, 10 tons 13 cwt. 2 qrs.; weight complete with trucks, but without electrical equipment, 17 tons 11 cwt. 2 qrs.

The floor is covered with a non-inflammable material called "lito-silo," 1 in. thick. The coach carries 64 passengers seated, and is well-lighted. Middle doors are provided, but these are only used at termini, and cannot be opened by the passengers from the inside of the coach.

It is believed that these steel coaches, besides being lighter than the old type in proportion to carrying capacity, and absolutely safe from fire, will have a very long life and cost little for maintenance beyond an occasional coat of paint. By their aid the company will be able to give an improved service, trains being run at 2½ minutes' interval, or less, throughout the day. At busy times 6-coach and 5-coach trains will be run on a two-minute headway; during slack periods the 6-coach trains will be split up into units each consisting of two cars. The 5-coach trains are indivisible.

The accompanying illustrations show the exterior of the coach, and the interior of the motor cab. In the former view a special feature is the arrangement of the electrical conductors, which are covered with asbestos, and are fixed in earthenware cleats in the channel of the sole-bar; they are normally protected with metal covers, which have been removed in order to show the conductors. These cables are required to connect the rear motor and shoe cable with the apparatus in the motor cab, and are placed in this position for the sake of cleanliness and accessibility; at the same time they are obviously well protected from injury and far removed from the floor of the coach, and it would be difficult to imagine a more ideal situation for them.

The view of the interior of the cab shows how the contactors, reversers and rheostats are all brought together in a position where they are always open to inspection and secure from dirt and damage; there is plenty of room in the cab, which has a floor space of 7 ft. × 9 ft., and the panels of the partition behind the electrical apparatus are removable, so that the gear is accessible on all sides. The connections



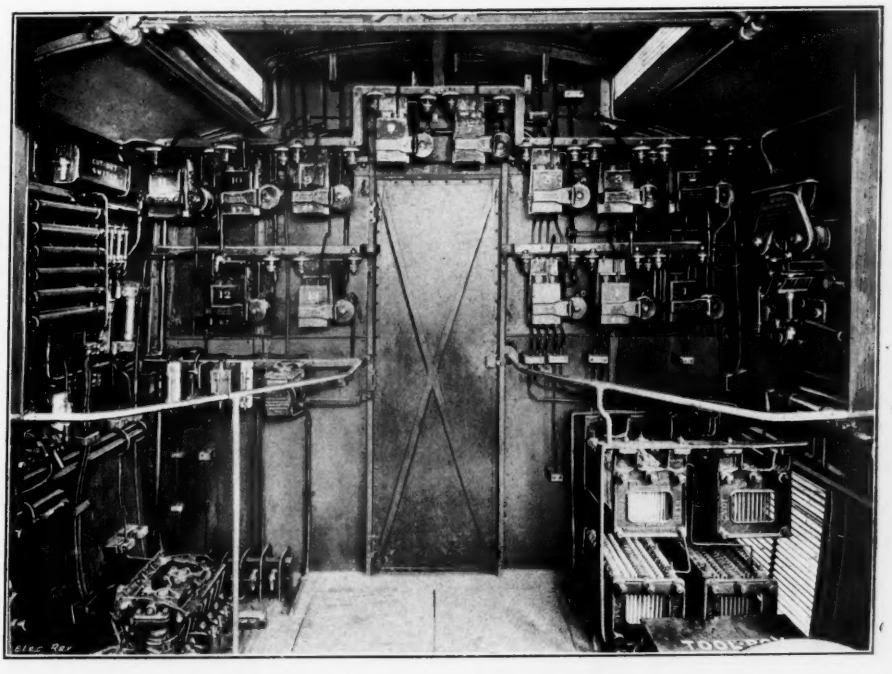
New Steel Motor Coach, Great Northern and City Railway.

are made by means of bare copper rods carried in earthenware cleats, and the whole arrangement is very substantial and workmanlike.

The controllers of the whole of the rolling stock are being fitted with the device known by the gruesome title of "the dead man's handle." This consists of a spring knob in the handle, which must be pressed down before the controller can be brought into action, and must be held down continually whilst the controller is in use. If it is released, even for a moment, a mechanical device comes into play and puts on the Westinghouse brake, while at the same time a switch in the controller cuts off the "juice." Thus, if the driver for any reason becomes incapacitated from performing his duty whilst on the road, the train is instantly pulled up. When this device has been fitted on all the controllers, it will be permissible to dispense with assistant drivers on the two-coach units, thus enabling the company to provide a greatly improved service without unduly adding to the cost. Two drivers, however, will still be employed on each of the longer trains.

The coaches are fitted with the Westinghouse rapid air-brakes, the motor-compressors and reservoirs for which are fixed under the frames.

By the courtesy of Mr. John Severs, we were enabled to make the round of the car depôt and repair shops at Highbury, where considerable changes had been made since our last visit. The shops are well equipped with lathes, presses, drills, &c., for ordinary repairs, but it is pleasing to record that the latter have been comparatively few and unimportant. Not a single traction motor has broken down during the two years that have elapsed since running commenced, and many of the commutators have not yet had to be turned up. The contact shoes have given no trouble, nor have the contactors. Happy is the railway with no history, so far as the repair shop is concerned! Such a record testifies both to the quality of the material—all British—and to the excellence of the management and supervision. For these important factors due credit should be given to the contractors, Messrs. S. Pearson & Son, Ltd. (who constructed the railway in its entirety, and are working it until the end of this year) and to their staff. The cables connecting with the contact shoes and motors are being encased in flexible metallic tubing, affording them excellent protection.



Interior of Driver's Compartment, showing Arrangement of Contactors, &c.

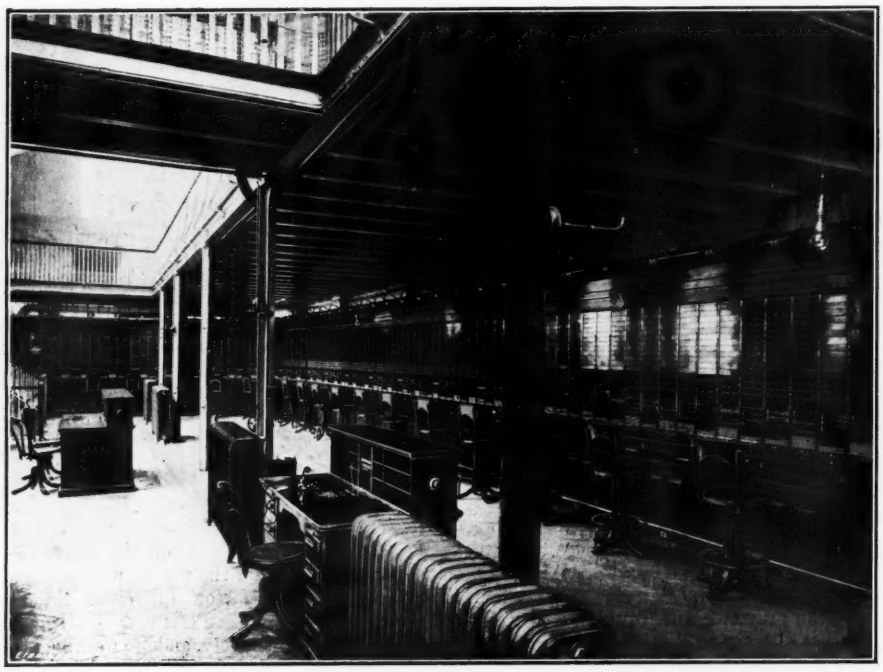
We are indebted to the engineer and traffic manager, Mr. R. P. Brousson, for the photographs herewith reproduced, and for most of the foregoing particulars, and to his chief assistant, Mr. John Severs, who kindly piloted us through the depôt and furnished us with abundant information regarding the new trains.

F

THE TRANSFER OF THE HOP NATIONAL TELEPHONE EXCHANGE FROM MAGNETO TO COMMON BATTERY WORKING.

By G. F. GREENHAM.

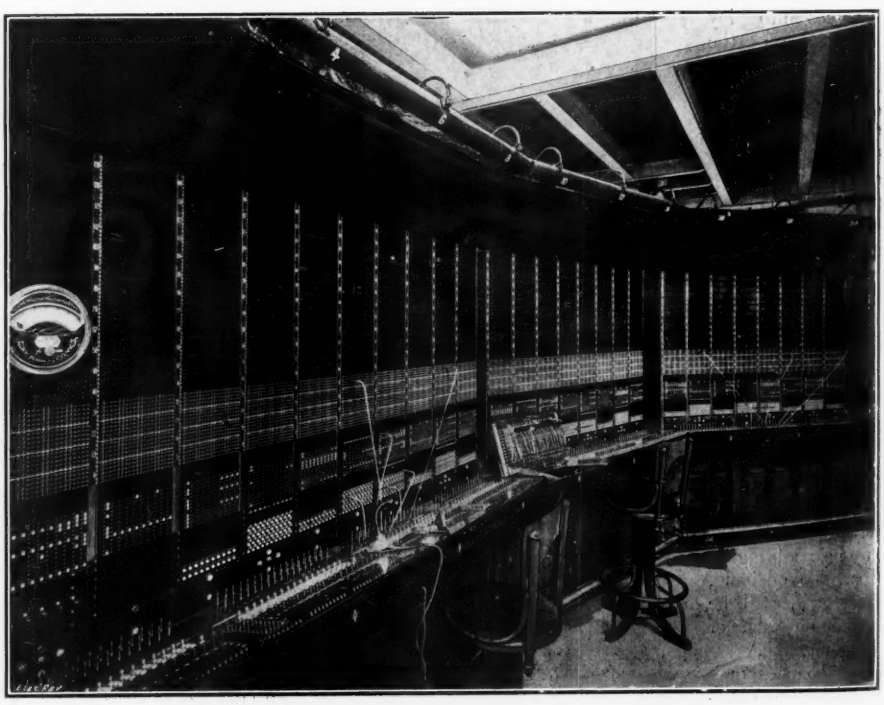
The following account of the opening of a C.B. Telephone Exchange, and the simultaneous transfer of all the working circuits from the old Exchange, will give some idea of the magnitude of the work, and the absolute necessity for attention to detail in order that the change may be made with the minimum of interruption to the service.



General View of the Subscribers' Operating Board, Third Floor.

The Hop C.B. Exchange, London, was successfully opened on March 17th this year, and 2,633 exchange lines, 4,900 stations, 1,057 junctions and 1,072 through lines were transferred from the old Exchange on the opposite side of Marshalsea Road, and started to work on the new system.

The two places are connected by a subway, and dry core cables were run through this and teed on to the existing cables in the old building, so that the working circuits were extended to the test frames in the new building but not through to the Exchange. The Exchange inspectors were occupied for many weeks in the new test room checking the records and proving the circuits. The through lines were connected on to the new test frame after business hours, and as they were tested O.K. the heat coils were joined up, thus completing the circuits *viâ* the new test room, the old connections being simultaneously severed. These through circuits were all dealt with prior to the opening day, and so required no attention then. The subscribers' lines were cross-connected on the test frame, and arranged on the distributing frame to suit the traffic requirements, and very carefully tested out, but were still left disconnected from the new Exchange. Perhaps the junction circuits demanded the greatest amount of attention owing to the very many different circuits involved. In a large proportion of cases alterations were entailed in the distant exchanges, and it was necessary to so arrange matters that the final change-over could be done practically instantaneously. Here again, much after-hour testing was necessary.



Near View of Subscribers' Board, Third Floor.

The actual procedure to be adopted in making the transfer required considerable care and forethought. The scheme briefly summarised was :—

1. To transfer to the new exchange, and test out *half* of the junctions from and to each Exchange, maintaining the service to the old Exchange on the other half.

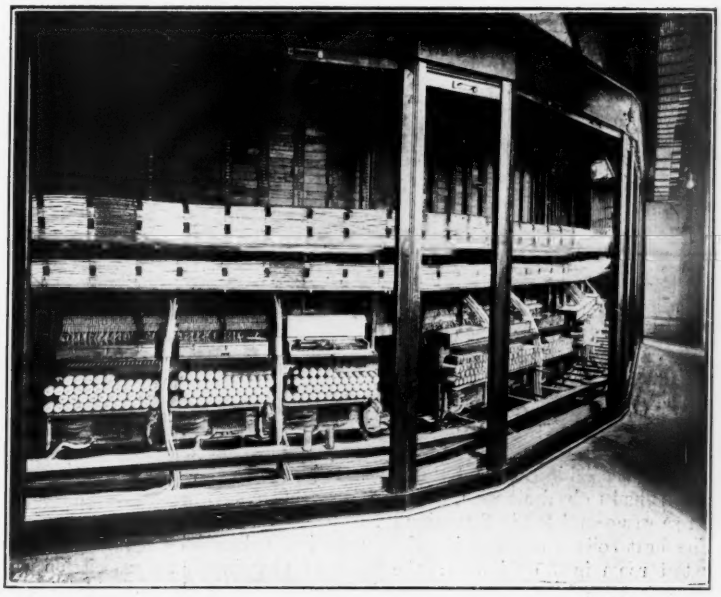
2. To transfer the subscribers to the new Exchange and maintain the service over the first half of the junctions.

3. To test the second half of the junctions from the new Exchange.

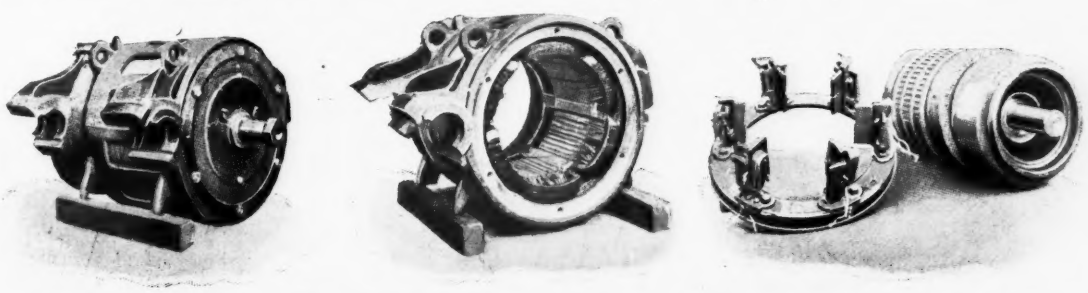
The men at the distant Exchanges were advised beforehand to make the alterations to the preliminary junction circuits at 2.30 sharp. It was decided to have a docket or slip of paper made out for each junction line and to distribute these dockets to the men told off to do the testing in the new Exchange. At the Hop Exchange the subscribers' boards are on one floor and the junction boards on another, and the work of junction testing was divided up between 20 men and four foremen. Two foremen, each with five men dealt with the outgoing junctions, and a similar number of men dealt with the incoming junctions. Each foreman was provided with a ruled schedule, showing each junction to be tested by his men, and the necessary dockets, previously made out and divided into sets, each set being placed in an envelope bearing the name of the tester. The procedure adopted in dealing with the dockets was as follows :—

As each line was tested, the result was endorsed on the docket, which was handed to the foreman of the group. After noting the result on his list of junctions, the foreman passed the docket on to the controller in charge of the whole operations. The controller kept a record of the result of all tests, and the dockets which were not endorsed O.K., were passed on to the test clerk or Exchange inspector for further attention. By this procedure it was possible for the controller to know exactly how matters stood, and what proportion of lines were faulty.

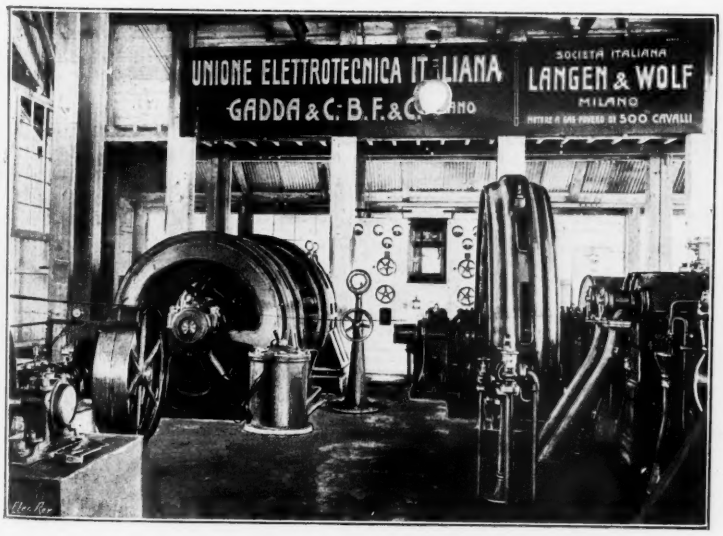
In order to disconnect the lines from the old Exchange and connect them on to the new, it was necessary to withdraw the heat coils from the springs of the cable bars in the old test room, and to insert the heat coils in the new test room.



Rear of the Subscribers' Sections on the Third Floor Top C.B. Telephone Exchange.



Single-phase Traction Motor and its Component Parts; Finzi-Gadda Railway, Milan Exhibition (see p. 382)



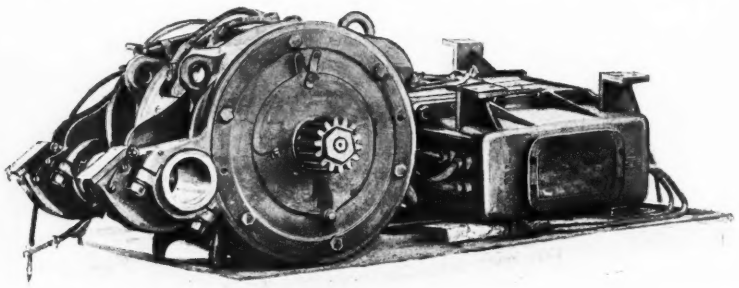
Generating Plant for Supplying Energy to the Finzi-Gadda Railway, Milan Exhibition.

The method adopted in the old test room for removing the heat coils rapidly, was as follows :—A piece of tape was passed down behind each group of heat coils, and the ends of this tape were tied together. It was, therefore, possible by one pull of the tape to remove 50 heat coils. As the process of putting heat coils in is a much longer one than withdrawing them, all the heat coils in the new test room in the subscribers' circuits, were inserted on the evening previous to the opening day, and in order to prevent the current flowing from the new Exchange over the lines and so interrupting their working, the springs of the cut-off relays were separated by microscope cover glasses, and it was arranged for the operators at the time of the transfer to plug in to each line so as to release the cut-off springs, allowing the glass to fall away thereby connecting the circuits through to the new Exchange.

The work in the old test room was carried out by a foreman with five men under him, and in the new test room there was a foreman with three men. The controller in charge of the change-over had a temporary switchboard connected up with lines to the various foremen, and direct lines to the chief Exchanges concerned in the change-over.

The transfer started as had been arranged, at 2.30 p.m. sharp. At 2.34, advice was received at the central point that the preliminary junctions in the old test room had been disconnected, and the foreman in the new test room was instructed to insert the heat coils in these lines in the new test room. This operation took 20 minutes.

At 2.55 the testing of the junctions was started, and was completed at 5.55. At 5.55 instruction was given to withdraw all heat coils in the old test room; 151 strips of 50 heat coils had to be dealt with, and the work of removing all these was completed in five minutes.



Motor and Transformer Ready for Mounting on Car: Finzi-Gadda Railway.

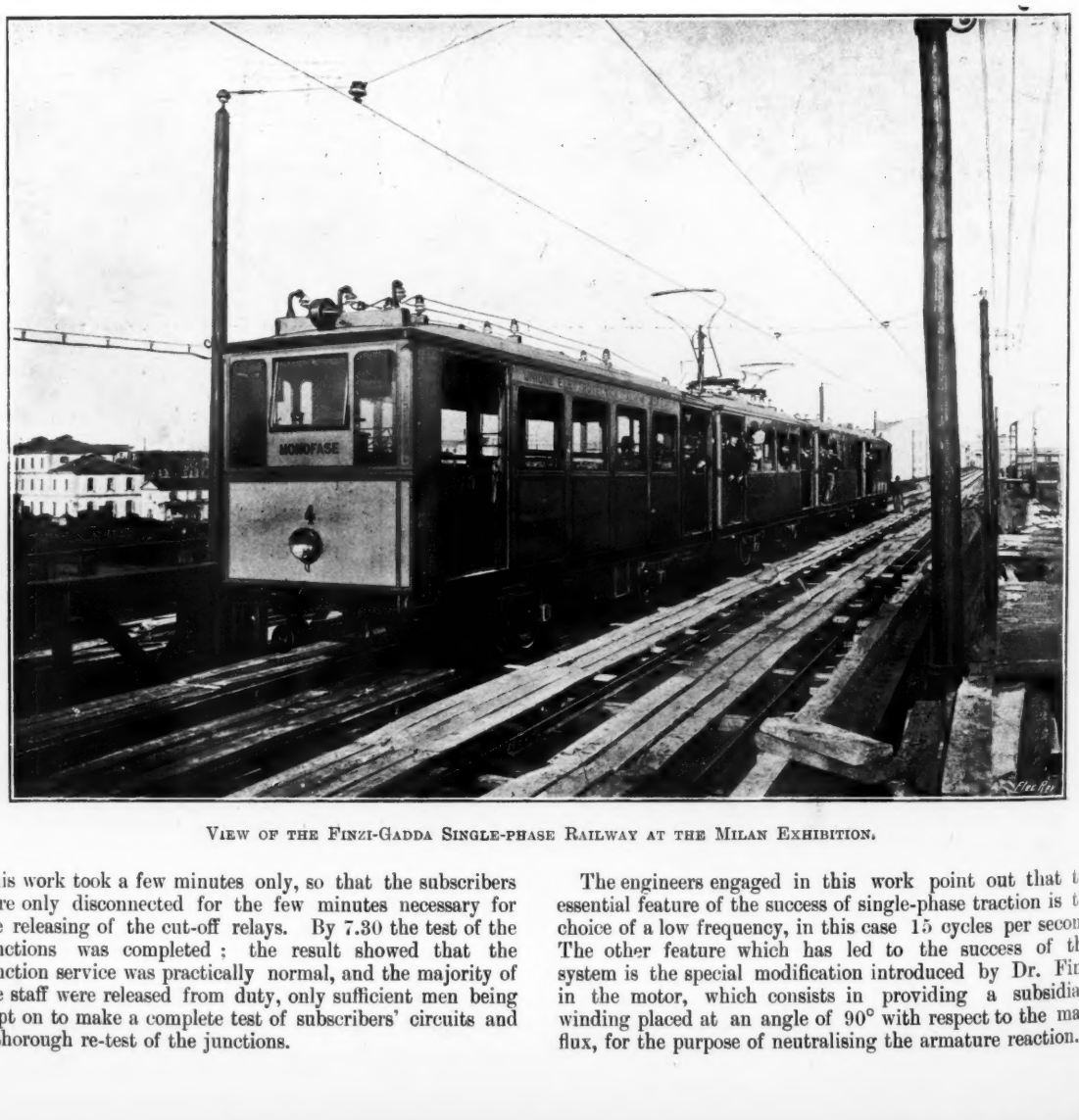
The heat coils of the final junctions were inserted in the new test room in 35 minutes; the work of plugging in to the subscribers' lines on the new switchboard was carried out by the operators who had been transferred to the new building, and the glasses in the cut-off relays were released. This work took a few minutes only, so that the subscribers were only disconnected for the few minutes necessary for the releasing of the cut-off relays. By 7.30 the test of the junctions was completed; the result showed that the junction service was practically normal, and the majority of the staff were released from duty, only sufficient men being kept on to make a complete test of subscribers' circuits and a thorough re-test of the junctions.

THE SINGLE-PHASE FINZI-GADDA RAILWAY AT THE MILAN EXHIBITION.

Electrical engineers visiting the Milan Exhibition will be especially interested in the single-phase railway, which serves as a connecting link between the two parts of the Exhibition, that is to say, between the Piazza d'Armi and the park. This railway was engineered, under the personal superintendence of Dr. Finzi, by the able staff of the Gadda Co.

Dr. Finzi states that the railway embodies the latest results of that long series of tests that were made, first on the Valtellina line, and later on the Milan-Mussoco road, where heavier cars were used, and more complete data acquired. It is of interest to note that some of the tests were run in the City of Milan on the tramway system there installed, and were conducted in the early hours of the morning when the regular system was not in operation, by disconnecting the direct-current supply, and using a single-phase alternator to supply the trolley wire.

The interest aroused in the technical Press recently by single-phase traction, and the announcement of Dr. Finzi's association with the Westinghouse Co. of America, and the combination of the patents of both parties, causes great interest to be attached to this railway, which is a complete up-to-date example of a high-tension single-phase road.



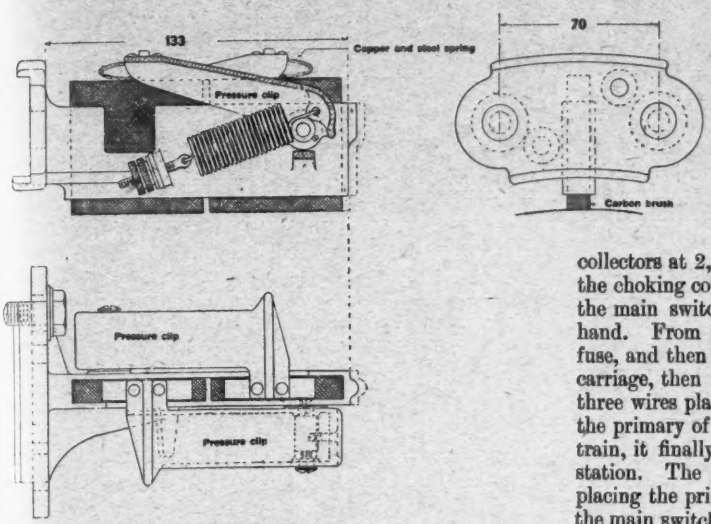
View of the Finzi-Gadda Single-phase Railway at the Milan Exhibition.

The engineers engaged in this work point out that the essential feature of the success of single-phase traction is the choice of a low frequency, in this case 15 cycles per second. The other feature which has led to the success of this system is the special modification introduced by Dr. Finzi in the motor, which consists in providing a subsidiary winding placed at an angle of 90° with respect to the main flux, for the purpose of neutralising the armature reaction.

The track passes over the streets of Milan, part of a public park, and also over the steam railway. At the points where streets and public places are crossed the viaduct is made of iron, the remainder being of wood.

A double track is provided throughout the entire length, except at the stations, and an auxiliary siding is provided at both stations, which can be made use of in case of emergency.

The length of the line is about 1,600 yards, the radius of the only curve is 300 ft., and the steepest gradient is 1 in



Dimensions in millimetres.

BRUSH-HOLDER FOR SINGLE-PHASE RAILWAY MOTORS.

30. The rails are of the type known as the "Rete Adriatica," and weigh 60 lb. per yard. They are used for the return current from the motor, and are bonded with copper bonds of ·10 sq. in. cross-section. The only alteration to the line as originally erected was the substitution of two Siemens bows instead of a single rhomboidal collector. In this connection it is interesting to note that the latter type was first installed to avoid danger due to the driver's forgetting to pull down both of the Siemens bows, if one were placed on each end of the train, in case it became necessary to examine the apparatus. Due, however, to some difficulty in the patent situation, it was decided to revert to the regular Siemens bows, and it is regrettable to add that a fatal accident recently occurred, due to their use.

The view of the viaduct, shown on page 382, indicates the type of trolley wire suspension employed, the line consisting of two wires of hard electrolytic copper, ·075 sq. in. in cross-section. The height above the ground is 18 ft., and a special elastic metallic suspension is used which enables the use of solder to be abandoned.

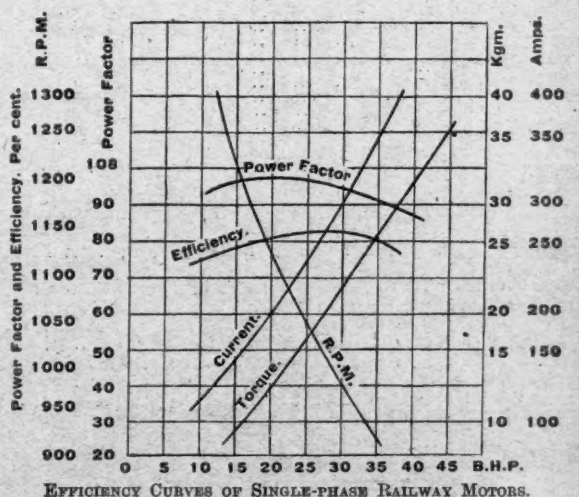
The trolley pressure being 2,000 volts, two points of insulation are employed, the second one being obtained by attaching the span wires to double-petticoat insulators on the top of the posts. All danger to passengers in the stations is avoided by carrying the line on the usual hanger, which itself is supported by two insulators attached to a wooden beam. This careful insulation of the line is made necessary, because it is proposed at the end of the exhibition to carry on experimental tests with pressures in the neighbourhood of 10,000 volts, and the insulation has been designed with this idea in view.

Two-horn type lightning arresters are used at each end of the line, and the trolley wire is set up zig-zag, to produce even wear on the surface of the collectors.

The generating station (see page 381) is situated directly below the Piazza d'Armi station, and contains a single-phase 2,000-volt alternator built with six poles, and operating at a speed of 300 r.p.m.; this machine is driven by a three-phase motor wound for 3,600 volts, supplied from the Exhibition power lines, and bolted to a common cast-iron base, the output of the set being approximately 600 H.P. A small alternator directly coupled to a Langey & Wolf gas engine is also employed, and these two machines have up to the present been sufficient to meet the demands of the railway.

The rolling stock consists of four regular trains, each consisting of four carriages with two more as reserves, the length of carriages is approximately 32 ft., with a wheel base of 13 ft. Each train is supposed to carry 250 passengers, but contains only 96 seats; a large space, however, is provided on the end platform, to which passengers are admitted. The maximum speed is limited by the exhibition authorities to 20 miles per hour on account of the light construction of the viaduct, but considerably higher speeds have already been obtained for experimental purposes. The arrangement of the train and the motive power is such that the system can be controlled from either end of the train. The transformers are divided into two parts, one being in the front carriage, and the other in the last. The current enters the collectors at 2,000 volts, 15 cycles, and after passing through the choking coil of the lightning arrester, enters the relay of the main switch; this can be operated automatically, or by hand. From the relay it passes through the switch main-fuse, and then the primary of the transformer in the first carriage, then passing along the train through one of the three wires placed on the roofs of the carriages, and entering the primary of the second transformer at the other end of the train, it finally returns along the track to the generating station. The third high-tension line just referred to is for placing the primary of the first transformer in parallel with the main switches.

The total equipment of the train consists of six motors, two on each of the end or driving cars, and one on each of the intermediate cars, these six motors being arranged in groups of three for each transformer. The motors start on the first position of the controller, which gives approximately half normal voltage, this being in Dr. Finzi's opinion the best starting pressure in general. Each step of the controller from two to seven, that is, after the first application of half-normal pressure, adds 30 volts to the transformer secondary, thus bringing the voltage up in six steps to 360



EFFICIENCY CURVES OF SINGLE-PHASE RAILWAY MOTORS.

volts, which for the three motors in series, gives an average value of 120 volts per motor.

The reversal of the motor is obtained in the same way as with direct current. The motors themselves are shown on page 381; they are provided with laminated poles and compensated winding as shown, the effects of this winding being to neutralise the armature self-induction, and improve the power-factor.

The brushes are the same in number as the poles—viz., six—and are carried on rigid rings. They are made as long and narrow as possible, and the constructional arrangement

is clearly shown on the preceding page. No resistance whatever is used between the armature conductors and the commutator segments. The armature contains 65 conductors in slots, and is built of steel stampings.

On first inspecting the car, the size of the controller seems excessive, but the currents to be handled are in the neighbourhood of 700 amperes, and ample size is imperative.

The design of the controller is adapted to enable either direct or alternating current to be employed, to permit of changing from one point to the next without breaking the circuit, and without causing excessive current, this latter point being taken care of by the provision of a choking coil inserted during the moment of change of contact. The system was laid down for a three-minute service, and this is easily maintained. Though slightly less than a mile in length, it offers an interesting example of the latest developments in European practice in electric railway work, and its operation will be closely watched. The acceleration of the motor is stated to be $\frac{1}{2}$ ft. per second per second, and the operation of the motor is extremely satisfactory, the commutation being very good.

The system has been operating only for a short time, but by the close of the exhibition it is hoped that a sufficient interval will have elapsed to show up any weak points and to provide some very interesting data.

The characteristic curves of the M.F. 25 motor in use on the railway are shown in the figure on p. 383.

Our special thanks are due to Messrs. Gadda & Co. and to Dr. Finzi, who kindly furnished full information to our representative, and had photographs prepared for our use.

TRAMWAY and RAILWAY NOTES.

(*Concluded from page* 378.)

Wolverhampton.—Below we give a brief summary of the working of the Corporation tramway undertaking for the year ended March 31st, 1906, together with comparative figures for the previous year:—

Year ended March 31st.	1906.	1905.
Total revenue	£41,905	£37,272
Total working expenses, including maintenance, renewals, &c.	29,642	26,894
Gross profit	12,263	10,378
Interest received	263	80
Interest charges	7,494	7,533
Sinking fund	3,840	3,453
Net profit	£1,192	£193
Miles of single track	20	20
Car-miles	950,338	809,508
Passengers carried	8,847,066	7,666,786
Total revenue per car-mile	10·58d.	11·05d.
Expenses per car-mile, including maintenance, renewals, &c.	7·44d.	7·97d.

Included in the working expenses given above is a sum of £5,364 for renewals. The reduction effected in costs per car-mile has resulted from a reduction in the cost of energy, increased car-mileage, and a general reduction in other ways; rates have increased.

The Corporation commenced a motor-omnibus service on the Lea Road on September 1st last year, but it was not until November that a proper service was organised. The receipts amounted to £1,199, or 9·06d. per mile run. Expenses were £1,379, or 10·55d. per 'bus-mile. The net result was a deficit of £180. No management charges, rents, rates, &c., were debited to the motor-'bus account. The 'bus-miles run amounted to 31,347, and the actual cost of tires per mile run was 2·138d.

TELEGRAPH and TELEPHONE NOTES.

Hamburg.—Sixteen telephone cables, each containing 500 conductors, have been recently laid at Hamburg across the Aussen-Alster. The width of the river where the cable has been laid is only 350 m. between Fahrdamm and Schöne Aussicht, the mean depth being 2·2 m. The length of each cable is 400 m. As the Alster possesses shallow landings, special precautions were taken. The cable was laid as deeply as possible in the river bed, and to effect this the river bed was dredged. The cable is also heavily armoured. The external diameter of each cable is about 90 mm., and the weight is 26 kg. per metre.

Hotel Telephones.—According to the *Globe*, quoting from a New York paper, one hotel in New York City does more telephone business than is transacted by the exchanges of many towns. The 1,177,648 persons who dined at the new Hotel Astor last year, and the 220,196 guests who slept there during the same period of time, are of a class who make much use of the telephone; yet the extent of their patronage is something of a surprise to those who see the figures for the first time. There was a total of 25,000 city calls registered at the hotel for the month of April, 1906, and for the same month 2,500 suburban and long-distance calls appear upon the record. Supposing the other months to show similar totals, the aggregate number of calls of all kinds, exclusive of those coming in, would be 330,000 for the year. The total revenue from telephone use is something like £10,000 annually. The hotel does a large telephone business with itself; there are fully 5,000 interior calls a day, for practically every need or desire of a guest is communicated by telephone. Guests are talked to by telephone as much as they talk; there is an average of 1,000 incoming calls a day.

New Cables. — Indo-China—Borneo. — The French Administration will soon open a new cable connecting French Indo-China (Cape St. Jacques) and Borneo (Pontianak). This cable, in conjunction with the Dutch and Eastern cables beyond, will create a new route for messages between Indo-China and other countries and Dutch Indies, Australia, New Zealand and New Caledonia. Moreover, the cable between Saigon (Cape St. Jacques) and Pontianak lands at the island of Poulo-Condore, thus also connecting this island with the International system.—*Journal Télégraphique.*

Azores.—The Eastern Telegraph Co. announces the laying and opening to International service of a cable between Porthcurno and Fayal, Azores. This will triplicate communication, in conjunction with a cable laid by the Western Telegraph Co. between Fayal and St. Vincent, with places served by the existing lines *vid* Porthcurno-Carcavellos and Porthcurno-Madeira-St. Vincent. The length of the cable is 2,444·640 kilometres, or 1,320 nautical miles. That of the Western Telegraph Co. is 2,708·180 kilometres, or 1,462·3 nautical miles in length.

Reunion.—The French administration announces that it is about to lay two cables between the above island and Madagascar and Mauritius. These cables will connect Réunion with the International system *vid* Mozambique or Mauritius, also securing communication between Madagascar and Mauritius.—*Journal Télégraphique.*

Java—Cocos Islands.—The Hague Minister for the Colonies has granted to the Eastern Extension, Australasia and China Telegraph Co. a concession authorising it to establish telegraphic communication between Java and the Cocos (Keeling) islands under the following conditions:—The concession will expire on December 31st, 1944. The Government telegraph office in Java, with which the cable will be connected, will transmit by its own employés any messages having to go by its lines. The Governor-General of the Dutch East Indies may also at any time appoint State operators to work the lines. Terminal and transit rates fixed cannot be increased without the consent of the Minister for the Colonies. The Netherland-Indies Government may suspend the service without being liable for damages. The concession may not be transferred in whole or part without the consent of the Minister of the Colonies.—*Ons Tijdschrift.*

West Africa.—The African Direct Telegraph Co. officially announces the opening of new telegraph offices at Gerihun, Baoma, Blama, Hangha, Commendi, Segbwema, Daru and Baima, in Sierra Leone, and at Bautchi, Barrijuko and Kontagora, in Nigeria.

The German Administration also announces the opening of new telegraph offices at Otjiwarongo and Aris, in South-West Africa.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1903	
St. Lucia-Martinique	May 7, 1903	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Cayenne-Pinheiro	Aug. 18, 1903	
Port Arthur-Chifu (Closed)	Mar. 7, 1904	
Tarifa-Tangier	Jan. 18, 1904	
Garachico (Tenerif)-Santa Cruz	July 12, 1906	
Bolamo-Bissao	July 24, 1906	
Curacao-La Guayra / Curacao-Coro (Closed)	Jan. 11, 1906	
Falmouth-Bilbao	Aug. 14, 1906	Aug. 31st.
Mole St. Nicholas-Port au Prince	Aug. 16, 1906	
Communication with Chile and Peru	Aug. 16, 1906	Sept. 1st.
Landlines.		
Puerto-Barrios	Aug. 23, 1903	
Bachkale-Deliman	Feb. 12, 1906	
Bagdad-Bassorah	July 17, 1906	

Wireless Telegraphy.—It is announced that Mr. Marconi intends to pay a visit to Italy this month for the two-fold purpose of inspecting the Coltano station and conferring with the Italian Government in regard to the international conference on wireless telegraphy which will be opened at Berlin on October 3rd. According to a Rome correspondent of the *Frankfurter Zeitung*, Mr. Marconi is no longer so determined that his apparatus must refuse to accept messages forwarded by other systems. The United States for the de Forest system, and Germany for the Slaby system, are fighting for the right of equal treatment of all systems and the duty of all stations to receive radio-telegrams from these systems. But according to official communications, the concessions made by Mr. Marconi are not so far-reaching and absolute as the Americans and the Germans ask for. The Berlin conference will not deal with the whole problem of radio-telegraphic communications, but only with the part which concerns telegraphy between ships and the shore on

the one hand, and between vessels on the other. As Germany has limited the proceedings to these points, it is believed that it will be easier to arrive at an agreement. The question of wireless telegraphic traffic between one country and another is of a complicated character, but will perhaps solve itself in the course of time. It is said that Belgium will propose at the conference the formation of an international board for the purpose of regulating the employment of wireless telegraphy in the shipping service with the admission of the various systems. The delegates at the conference will only have a limited mandate, and eventual agreements will be sanctioned by conventions between different States.

A system of wireless telegraphy has been established on the Swiss mountains, where it is said to be possible to receive messages dispatched from the Poldhu station in Cornwall. One station has been erected on the Rigi-Scheidegg and another at Fort Stockli, a distance of 27½ miles apart, the work having been carried out by the Berlin Wireless Telegraphy Co. It occasionally happens that the station on the Rigi-Scheidegg gets within the sphere of action of the Poldhu station, which between 12 o'clock midnight and 2 a.m. sends messages to vessels at sea. This is reported to be the case when the atmospheric conditions are favourable and the wave lengths are brought into harmony, and under these circumstances the Swiss station picks up the English signals, the distance being over 620 miles.

CONTRACTS OPEN and CLOSED.

OPEN.

Blackrock (Co. Dublin). — September 22nd. The Main Drainage Board wants tenders for an electric power installation. See "Official Notices" to-day.

Dublin.—September 8th. Arc lamps and arc lamp pillars for the Corporation. See "Official Notices" August 24th.

Dublin.—September 8th. 500 A.C. meters, single and three-phase, for the Lighting Committee. See "Official Notices" August 31st.

Edinburgh.—September 12th. Electrical wiring and fittings for the Police Fire Station, at Stockbridge. See "Official Notices" August 17th.

Handsworth.—September 15th. Electric wiring for the Council's new schools. See "Official Notices" August 10th.

Johannesburg.—October 15th. Tenders are required by the T.C. for single-phase alternating current motors with accessories. See "Official Notices" August 31st.

Merthyr Tydfil.—September 20th. Stores for the Hill's Plymouth Co., Ltd., for 12 months, including india-rubber, asbestos, electrical appliances, &c.

Rathmines (Co. Dublin).—September 12th. The U.D.C. wants tenders for electricity supply mains, house fuse boxes, house meters, extension of switchboard, extension of accumulators, and battery booster. See "Official Notices" August 24th.

CLOSED.

Accrington.—The T.C. has accepted the tender of the British Thomson-Houston Co. for a year's supply of electric motors.

Bolton.—The Corporation Electricity Committee has accepted the tender of Messrs. Musgrave & Sons, Ltd., for the supply of two Lancashire boilers, and of Messrs. Ferranti, Ltd., for a three-phase switchboard. The Corporation Scavenging Committee has accepted the tender of the Corporation Electricity Committee for the installation of the E.L. at the Hacken Works.

Bruce Peebles Contracts.—Messrs. Bruce Peebles and Co., Ltd., have secured the following contracts:—

For *Shanghai Municipality* through Messrs. Preece & Cardew, acting on behalf of the Municipality, an order for extension plant for the electricity works, including two Peebles-Belliss 600-KW. steam dynamos with condensers, pipe-work, &c., one 300-KW. motor-generator, high and low tension switchboards, cables and sundries.

For *Bristol Corporation*: Order for one 500 and two 300-KW. Peebles-La Cour motor converters, to convert 6,000-volt three-phase to 500-550-volt continuous current. (Repeat order.)

For *Natal Government Railway*: Order received from Messrs. Hubert Davies & Spain, as main contractors, for a 200-KW. motor converter converting 6,000/6,600-volt alternating current to 500/550-volt continuous current. (Repeat order.)

For *Duchy Development Association, Ltd.*: Order for two 200-K.V.A. rope-driven three-phase alternators.

Brush Contracts.—The Brush Electrical Engineering Co., Ltd., has booked the following contracts:—

For the Belfast Corporation Tramways three standard 4-wheel trucks.
For the Kidderminster Electric Lighting and Traction Co. equipment of electric motors for Humphrey's Carpet Beating Factory.

Chertsey.—The B. of G. has accepted the tender of the General Electric Co., Ltd., for the supply of telephones.

Dover.—The Tramways Committee of the T.C. has accepted the tender of the Railway and General Engineering Co. for the supply of a quarter of a mile of renewable plate system of joining ends of tramrails, at £200.

Gloucester.—The Light Railways Department has accepted the tender of Messrs. Johnson & Phillips, Ltd., for the supply of dynamo-superfine and micanite tape for the ensuing 12 months.

Halifax.—The Corporation has accepted the tender of the British Insulated and Helsby Cables, Ltd., Prescot, for the supply of cable required for two 3-wire feeders to be laid from the electricity works to the sub-station in George Street, at the following prices:—

1 sq. in. cable	£1,490 per mile.
·5 sq. in. cable	794 "
·6 sq. in. cable	915 "
·3 sq. in. cable	507 "

Heckmondwike.—The U.D.C. has accepted the tender of the Tudor Accumulator Co., Ltd., for the repair of the lighting battery and its maintenance for 10 years.

Key Engineering Contracts.—The following contracts for fibre conduit have recently been secured by the Key Engineering Co., Ltd., of London and Manchester:—

For the London Electric Supply Corporation, 50,000 ft. of 3-in. fibre conduit.
For the Melbourne Corporation, 54,000 ft. of 3-in. fibre conduit.
For the Bournemouth and Poole Electric Supply Co., 36,000 ft. of 2-in. fibre conduit.
For the Glasgow Tramways Department, 90,000 ft. of 2½-in. fibre conduit.

Plymouth.—The Electricity and Street Lighting Committee has recommended the acceptance of a tender of Messrs. Cory Bros. for the supply of 5,500 tons of Powell-Duffryn coal, at 14s. 5½d. per ton.

Scarborough.—The T.C. has accepted the tender of Messrs. Walker & Hutton, of Scarborough, for the supply of electric motors for driving stone-breaking machinery, at £226, and that of Messrs. Shepherd & Watney, of Leeds, for supervising the erection of the electric plant.

Tasmania.—The Agent-General has placed an order with Messrs. Johnson & Phillips, Ltd., for a motor-booster and switchboard for the Hospital for the Insane, New Norfolk.

FORTHCOMING EVENTS.

Saturday, September 8th.—At 7.30 p.m. Birmingham and District Electric Club. Opening meeting of the session. Election of members, &c.

Monday, September 10th.—North of England Institute of Mining and Mechanical Engineers. Excursion meeting at Shincliffe.

September 12th, 13th and 14th.—Institution of Mining Engineers. Annual general meeting at Grand Hotel, Hanley, at 11 a.m. (12th). Papers for discussion:—"Commercial Possibilities of Electric Winding for Main Shafts and Auxiliary Work," by Mr. W. C. Mountain; "Electrically-driven Air Compressors combined with the working of Ingersoll-Sergeant Heading Machines," by Mr. A. Thompson; "Practical Problems of Machine Mining," by Mr. S. Mavor. At 4.15 p.m.—Visit to Messrs. Cowlishaw, Walker & Co.'s works. Compressed air and electrically-driven bar coal-cutting machines will be shown in operation. Thursday (14th).—Visit to the Sneyd Collieries at Burslem to inspect polyphase electrical plant, &c.; also Florence Colliery, Longton, to view surface arrangements and plants, electrical machinery, &c. Various other visits to works, &c., are on the programme.

NOTES.

Siemens Institute Athletic Sports.—On Saturday, the 25th ult., the first annual sports in connection with the Siemens Institute, were held at Stafford. The events were confined to employés of Messrs. Siemens Bros.' Dynamo Works, Ltd.; a good programme was provided, the weather was fine and there was a large attendance of spectators, about 2,000 paying for admission to the ground. The obstacle race included two water jumps, one of which defeated nearly every competitor, and an inclined plane of smoothly planed boards, 12 ft. high, and at a steep angle, also presented considerable difficulty. Twenty-two teams representing different departments entered for the tug-of-war, and the contests were carried out up to the third round on the previous evening; eventually the pattern-makers beat the carpenters, with difficulty. The staff, however, in a separate tug-of-war, easily overhauled the works. Mr. E. Goodey won the championship, and will receive a gold medal. It was announced that next year open events would be introduced. After the athletic sports there was a dance, and the proceedings ended as they began, very successfully.

Structural Changes in Nickel Wire at High Temperatures.—A paper was read before the British Association, Section G, by Prof. H. C. H. Carpenter, on a research carried out in

order to ascertain, if possible, the reason for a fundamental change in the mechanical properties of nickel wire used as the heating coil of an electrically heated porcelain tube-furnace.

The wire contained 98·60 per cent. nickel, 1·22 per cent. iron, 0·16 per cent. manganese, and a trace of cobalt. Some dissolved gas or gases were also present. The diameter of the wire was $\frac{1}{78}$th of an inch. The ultimate tensile stress was 35·2 tons per sq. in., with a percentage elongation of 34·4 on 3$\frac{3}{8}$ in. and a percentage reduction of area of about 70. The resistivity at 0° C. was 9·2 microhms-cm. In building the furnace the wire is wound round an unglazed porcelain tube (1$\frac{1}{2}$ in. external diameter), which is enclosed in a wider one, the intervening space being filled with crushed quartz. The ends of the furnace consist of porcelain slabs which fit into the wider tube, and are bored so as just to allow the passage of the narrower tube. In actual use the wire carries 20 amperes at 50 volts pressure, and a temperature of 1,200°-1,300° C. can be obtained in the tube. With care the life of such a furnace is usually three or even more months; but sooner or later it breaks down. The wire is then usually found to be so brittle that it can be snapped between the fingers. Occasionally it is still tough, but has become perfectly fibrous. These changes of mechanical properties are accompanied by structural changes which have been studied with the microscope. They are the result of the *combined* influence of heat and electricity, and are not produced by either of these agencies singly.

It appears that the changes are due mainly to two effects, viz., re-crystallisation and the penetration of gases, which are themselves the result of heat and electricity on the metal. The frequent association of brittleness with gross crystallisation has long been known. But the evolution of dissolved or combined gas or gases from nickel and their mode of penetration through and eventual exit from it by means of cracks between the gross crystals are, it is thought, described here for the first time. These facts are illustrated by photomicrographs in the complete paper, and a tentative explanation based on general physical principles is put forward.

The Electric Smelting of Iron Ores.—The recent successful experiments in the smelting by electrical methods of magnetic ores at Saulte Ste. Marie, by Dr. Haanel, on behalf of the Canadian Government, have attracted widespread attention throughout the world. The authorities at Ottowa have been innundated with inquiries, and it is rumoured that there is good reason to believe that one of the big Pittsburg iron magnates has in contemplation the establishment of an iron smelting industry in Canada at some point where electrical energy can be cheaply obtained. Dr. Héroult's representative, who took part in the Canadian investigations, has informed an Ottawa correspondent that the first electric smelting plant is to be fitted up at Band, California, and will be completed in about six months' time. The plant will consist of one 2,000-H.P. electric furnace, with a guaranteed output of 20 tons per day of pig-iron, and if this initial plant is successful, it is intended to increase the plant so as to be capable of smelting from 600 to 800 tons a day—the greater part of which will be converted into soft-steel for structural purposes.

The Woolwich Appointment.—We have received the following letter dated September 5th from Mr. Gilbert Slater, Mayor of Woolwich:—

"My attention has been drawn to a letter in your issue of August 24th commenting adversely on the method in which candidates for the appointment of commercial assistant in the electrical department of this borough were dealt with.

"It is true that about 200 applications were received, and that 11 were selected and interviewed by the Electricity Committee, and that of these six were recommended for the consideration of the Establishment Committee, and that, nevertheless, no appointment was made. The explanation is, that, after very careful consideration, the Establishment Committee came to the conclusion that none of the six applicants recommended to them was entirely suitable for the post, which requires not only commercial experience and electrical knowledge, but also natural gifts of an order which it is very difficult to specify in the advertisement or to test in a candidate.

"It was with very great regret that the Committee determined not to make an appointment, and came to the conclusion that the salary offered was not sufficient.

"Your correspondent draws attention to the fact that the candidates had hopes raised which were doomed to disappointment. This must necessarily be the case whenever an appointment is advertised, for all candidates except the one successful one.

"Your correspondent further complains that in some cases present employers were written to for references. This was not done in any case in which the candidate indicated that he desired that his candidature should be treated as confidential."

Petrol Motor-car on the N.E. Railway.—We are informed that an error occurred in our article on the N.E.R. petrol electric car, which appeared in our last issue. The motors are not of the type named, but were supplied by the British Thomson-Houston Co., Ltd., of Rugby, of their type G.E.74. We regret the error, which did not originate with us.

Appointments Vacant.—An assistant engineer is wanted for Hebden Bridge Electricity Works. Vacancies occur for station supervisors at the generating station at Portsmouth Dockyard; charge engineer for Stepney (£2); two telegraph inspectors and one telegraph mechanic are required for Southern Nigeria; shift engineer for the winter months for Rathmines. See our advertisement pages to-day.

Educational Notes.—BOROUGH POLYTECHNIC INSTITUTE.—Evening classes commence on 24th inst. Courses of instruction in electrotechnics are arranged to cover several years, and there are excellent laboratories equipped with up-to-date plant and apparatus. Under the Chemistry Department lectures are arranged on the electrolytic deposition of metals, electrolytic refining of copper and nickel, production of chlorites, &c., manufacture of aluminium, sodium, magnesium, &c. The head of the Physics and Electro-technical Department is Dr. J. Henderson, and of the Chemistry Department, Dr. F. Mollwo Perkin.

SOUTH-WESTERN POLYTECHNIC.—The prospectus for both day and evening classes for the Session 1906-7 has been issued, and we note that the day college term commences on October 1st. Evening classes, however, commence on Monday, September 24th, and intending students can take out their tickets on the 19th, 20th or 21st inst. Those doing manual work are strongly recommended to attend classes on two evenings per week only. The head of the electrical engineering department is Mr. A. J. Makower, and Mr. U. A. Oschwald is senior demonstrator.

UNIVERSITY COLLEGE, BRISTOL.—Courses in electrical, mechanical, civil, and mining engineering and surveying are conducted at the college. Special facilities are offered in the way of engineering works scholarships, arrangements being made with firms in or near Bristol for practical training to be obtained in works concurrently with the college course. The head of the Engineering Department is Prof. R. M. Ferrier, M.Sc.

CORRESPONDENCE TUITION.—Prof. A. Jamieson, M.Inst.C.E., has issued a prospectus relating to his courses of instruction by correspondence in electrical and mechanical engineering science, in which special arrangements are made in connection with the Inst.C.E. examinations, Government appointments, and degrees in engineering.

For further particulars of the foregoing, see our advertisement pages to-day.

Engineering and Machinery Exhibition.—In connection with the Exhibition which opens at Olympia on Saturday next week, a luncheon was given by the President and Committee at the Trocadero on Friday last. Mr. J. H. R. Whinfield, of Messrs. Sir W. G. Armstroug, Whitworth & Co., Ltd., occupied the chair, in the absence of Sir William H. White, and was supported by representatives of several engineering and allied institutions. Proposing the toast of "Success to the Exhibition," the chairman stated that it was 21 years since a similar exhibition had been held in London, and he drew attention to the vast progress that had been made in various departments of engineering in the interval, referring especially to "high-speed" tool steel. Mr. Bridges responded, and Mr. Perry F. Nursey, secretary of the Society of Engineers, in a neat speech, predicted a successful result equal to that of the previous exhibition held in 1885, with which, as with the forthcoming one, he was connected in an official capacity. It was announced that there would be about 200 exhibitors, and that practically all the space was taken.

Rail Corrugations.—A correspondent writes as follows:—"I believe it has been stated by many that corrugations have never been known to develop on steam lines.

"I happened to visit Whitstable last month, and while rambling round the town crossed the S.E. & C. Railway about a mile from Whitstable Town Station (Herne Bay side). The crossing is only a footpath, which is used as a near cut across the fields to the sea front. As we crossed the rails I noticed the treads had quite a wavy appearance. Examining the rails more closely, I was surprised to find that quite pronounced corrugations had developed. The track at the crossing mentioned above is straight, and the rails appeared fairly new. The construction is ordinary ballasted sleepers."

This observation is of material interest, and we should be glad to receive further particulars of this and of any similar instance of rail corrugation on steam railways.

Platinum.—It will be noticed that in our "Market Quotations" during the past two months platinum has not been priced. We are informed by Messrs. Johnson, Matthey & Co. that there is practically no market, owing to the disturbed condition of affairs in Russia. The price of the metal is continually fluctuating; indeed, it does so to such an extent that the company is unable to give a fixed quotation. The price on Wednesday afternoon last was in the neighbourhood of 105s. per oz.

Electric Clocks.—According to the *Electrical Record* the Railway Commissioners of New South Wales are adopting a system of electrically-synchronised clocks at the new Sydney Central Railway Station. A German system has been adopted, costing £80 for three dials and a master clock, as against £33 for a British system, but the cost of maintenance quoted for the former was 6d. per clock per annum, and the British system £1 per clock per annum. It was stated recently by the electrical engineer that the German system was superior in design and workmanship to the British. Be that as it may, the figures given for maintenance are obviously absurd. Assuming that they are per dial, allowing £4 per annum for the British against 2s. for the German, with 5 per cent. interest and 10 per cent. depreciation in both cases, the annual cost of the German system is over £12, as compared with £9 for the British. If the rates are per master clock, the comparison is £12 against £6.

There is at least one thoroughly sound and well-tried British system extant, to our knowledge, and we gravely question the alleged superiority of the German system. The true reason for adopting the latter, we fancy, is not disclosed in the official statement

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Engineers.—At Houghton-le-Spring, County Durham, on Monday evening, a dinner was held at which were present the staffs of the Durham Collieries Electric Power Co., Ltd., and Messrs. Bruce Peebles & Co., Ltd. The dinner was followed by a highly successful musical evening. During the course of the evening, Mr. W. J. S. JONES, the resident engineer for the Durham Collieries Electric Power Co., presented Mr. DAVID ARMITAGE, mains superintendent, on behalf of those present, with a solid silver cigarette case and match-box on the occasion of his marriage. Mr. G. NEVIL THOMAS, Messrs. Bruce Peebles & Co.'s representative, also presented Mr. G. ALINGTON K. JOHNSON, on behalf of the staff, with a solid silver tea and coffee service on the occasion of his leaving the firm to join the staff of the Durham Collieries Electric Power Co.

Mr. C. S. COLLISON, who has resigned his post as switchboard attendant at the Loughborough Corporation electricity department in order to take up an appointment in charge of the plant at the General Post Office, Leicester, was on Saturday last presented with a clock, letter wallet, and card-case by the members of the staff. Mr. W. H. ALLEN, the borough electrical engineer, made the presentation.

At the Watford U.D.C. electricity works on Wednesday last week, the employés made a presentation to Mr. W. H. F. COLEBROOK, the late engineer. Mr. J. R. Weston, chief engineer, on their behalf presented Mr. Colebrook with a case of briar pipes, a tobacco pouch, and a silver cigarette case.

The Todmorden T.C. on August 29th appointed Mr. TALBOT, of the gas works, as electrical engineer, his salary to be increased by £25 a year; Mr. T. H. HOLLAND, as manager of the electricity works, at a salary of £150 per annum; and Mr. EDWARD BRUNT as engineer at £2 5s. per week.

A Sydney paper says that on July 19th a complimentary farewell dinner at Paris House was given by the directors of the Empire Electric Light Co. to Mr. J. R. WOODRUFFE GARDAM, M.I.C.E., M.E.V.W., chief electrical engineer and manager of the company. Mr. Gardam was leaving for Europe on six months' leave, to study the latest developments in electrical science. Mr. R. Imray was in the chair. The guest was presented with a camera.

A Newcastle paper stated on 31st ult. that the Sunderland Electricity and Lighting Committee had selected the following six out of 69 applicants for the post of electrical engineer to the Corporation:—Messrs. Blackman, A. A. Day, Proctor, Shawfield, Taite, and Wilmshurst.

The Erith U.D.C. has filled the position of assistant engineer at the electricity works by the appointment of Mr. H. E. MIDGLEY, M.A., A.M.I.C.E.

Tramway Officials.—Mr. W. G. GORDON has been appointed manager and electrical engineer of the Essendon and Flemington electric tramways in Victoria, which are in course of construction.

Mr. G. R. BLACKBURN, who has just left the position of assistant electrical engineer and works manager of the Bradford Corporation Tramways to take up the duties of rolling stock superintendent to the Manchester Corporation, has been made the recipient of the gift of a bookcase bearing a plate with a suitable inscription, as a present from his Bradford colleagues. The presentation was made by Ald. Enoch Priestley, chairman of the Bradford Tramways Committee.

General.—Mr. PHILIP C. POPE, lately in charge of the consumers' department of the Lancashire Electric Power Co., has been appointed branch manager of the new office just opened in Manchester by Messrs. Siemens Bros.' Dynamo Works, Ltd., and can be found at their address, 196, Deansgate, Manchester. Mr. H. Wynne Pierce has left Messrs. Callender's Cable and Construction Co., Ltd., with whom he has been for the past six years as construction engineer, and Mr. G. Seton Chisholm has resigned his position with the Howard Asphalte Troughing Co., Ltd., both gentlemen having become associated with the Manchester branch office of Messrs. Siemens Bros.' Dynamo Works, Ltd., at the above address.

Mr. WM. WHITE, M.I.E.E., has resigned his position with the General Electric Co., and has taken offices at 3, Budge Row, Cannon Street, E.C.

Mr. W. H. PATCHELL, who, as already announced, is now engaged in private practice as consulting engineer, removed to his new offices at Caxton House, Westminster, S.W., on Saturday last, 1st inst.

Mr. DOUGLAS FARRAR, assistant lecturer in electrical engineering at North Wales University College, Bangor, has been appointed lecturer in electrical engineering at Hartley University College, Southampton.

A Canadian correspondent says that Mr. ORMOND HIGMAN, chief of the Electrical Standards Laboratory of the Inland Revenue Department, Ottawa, has been selected by the Canadian Government to represent the Dominion at the International Commission, which has been called to meet in London in October next to consider the question of electrical units and standards. Mr. Higman has similarly represented the Canadian Government on two previous occasions, viz., at Chicago, in 1893, and St. Louis in 1904.

M. H. RODOLPH, Inspector-General of Posts and Telegraphs of the Dutch East Indies, has retired, and the Dutch Government has appointed in his place Mr. J. J. STIELTJES, second-class engineer in the Department for the Construction of State Railways.

The President of the Western Union Telegraph Co. has informed the Bureau Internationale that Mr. T. W. GOULDING's title has been changed from "General Superintendent" to "European General Manager." Mr. Goulding is the London representative of the Western Union.

Mr. W. M. MADDEN, M.A., M.I.E.E., has resigned the editorship of the *Electrical Times*. The new editor will be Mr. ERNEST SLATER, M.I.E.E., A.M.I.M.E.

Mr. FRANCIS E. DRAKE, who has just been appointed general manager of the Société Anonyme Westinghouse, of Paris, and Le Havre, was in his earlier experience sales manager of the Standard Electric Co., of Chicago, for five years, and for nearly two years he was manager of the Walker Electric Co., Cleveland, when the United States Government appointed him Director of Machinery and Electricity at the Paris Exposition (1900), for the purpose of organising what was threatening shortly to become an embarrassing situation for the United States exhibitors. We understand that when Mr. Drake came on the scene he found that, with careful pruning and making a liberal allowance for withdrawals, the *bonâ fide* intending exhibitors required more than three times the space at his disposal. Those who remember the American electrical and machinery section of that year, and its unique annexe, housed apart in a beautiful building at Vincennes, will be interested to learn that Mr. Drake was responsible not only for the idea of a separate building, but also for its complete design, construction and lay-out. The idea was a great success, giving every satisfaction to the American Government as well as to exhibitors, and resulted in his being decorated by the French Government. In 1901 Mr. Drake was appointed to reorganise the works of the Union Electricitäts Gesellschaft, of Berlin, which he carried through and finished in 1903. The following two years found him again in America as president of the Lanyon Zinc Co., one of the largest zinc smelting firms in the world. In April, 1905, Mr. Drake returned to Europe to organise the Continental business of the Chicago Pneumatic Tool Co., and founded in Berlin the Internationale Pressluft und Elektricitäts Gesellschaft, m.b.H., of which concern he is general director. Mr. Drake is also a director of the Consolidated Pneumatic Tool Co., Ltd., of London, and a member of the Engineers' Club and the Lawyers' Club of New York.

Obituary.—We learn with regret that the death occurred on August 11th, at Bombay, of Mr. S. JOYCE, M.I.E.E., Professor of Physics and Electrical Engineering, Victoria Jubilee Technical Institute in that city.

We regret to learn of the death, on Thursday night last week, of Mr. C. W. PHIPPS, M.Am.I.M.E., who has occupied the position of works manager to the British Thomson-Houston Co., Ltd., Rugby, for the past five years, in fact, ever since the works were started at Rugby. Although it was known that Mr. Phipps was seriously ill, the termination of his trouble has come to his friends in Rugby, and elsewhere, as a shock, and we understand that the tidings of his death cast quite a gloom over the works, for he was extremely popular amongst all grades, from the heads of the departments to the men forming the rank and file. Mr. Phipps was 47 years of age and a native of Worcester. Early in life he migrated to America and became closely identified with the pioneers in the electrical industry in that country, himself doing a great deal of pioneer work. He was for some time manager of the Brush Electrical Works at Cleveland, Ohio, and in the interests of this company and for the purpose of introducing the Brush Electric Arc lamp, travelled all over the world, installing some of the first arc light appâratus in the United Kingdom, and being the first to introduce and install a search-light in Japan. Mr. Phipps was also works manager, after his world trip, for the Adams Bagnall Co., of America, and after the absorption of the American Brush Electric Co. by the G.E. Co., of America, his services were secured by the G.E. Co. so as to obtain the benefit of his ripe experience. Mr. Phipps remained with the G.E. Co., being attached to their New York Office, until his appointment to the post of works manager at Rugby, which he filled with such credit to himself and satisfaction to the B.T.H. Co. He leaves a widow and a son, the latter a pupil at Rugby School, to mourn his loss.

NEW COMPANIES REGISTERED.

Cascade (1906) Power Co., Ltd. (89,964).—This company was registered on August 27th, with a capital of £75,000 in £1 shares, to acquire the assets and undertaking of the Kettle River Power Co., Ltd., incorporated in October, 1900 (free from the charge created by such company under a trust deed dated June 19th, 1901, upon the property, rights, privileges, powers, shares, stock and securities held by the said Kettle River Power Co., Ltd., of the Cascade Water Power and Light Co., Ltd., a company incorporated by an Act of the Legislature of the Province of British Columbia, 60, Vict. ch. 51, the short title whereof is the Cascade Water Power and Light Co., Ltd., Act, 1897), to adopt an agreement with A. G. Bartholomew (Receiver on behalf of the said debenture holders), and to carry on in the B.C., U.S.A. and elsewhere the business of an electric light, heat, power, telegraph and telephone company in all its branches. The first subscribers (each with one share) are:—C. A. Smith, 695, Salisbury House, E.C., chartered accountant; E. F. Goodall, 335, Clapham Road, S.W., chartered accountant; H. Robbins, 8, Shanklin Road, Crouch End, N., cashier; H. Plater, 40, Stafford Road, Upton Manor, Essex, clerk; J. Buckingham, 34, Chestnut Avenue, Forest Gate, E., clerk; C. E. Fayle, 9, Royal Parade, Muswell Hill, N., clerk; and R. Humphreys, 20, Meynell Road, South Hackney, N.E., clerk. No initial public issue; the number of directors is not to be less than two or more than five; the subscribers are to appoint the first; qualification, £50; remuneration (except managing director), £250 per annum, divisible. Registered office, 695, Salisbury House, E.C.

P. and H. Syndicate, Ltd. (90,019).—This company was registered on August 31st, with a capital of £20,000 in £1 shares, to construct, maintain and work either with or without steam, electricity or other power, or acquire, lease or obtain running powers over any tramways or railways in the United Kingdom, and to carry on the business of tramways and railway proprietors, suppliers of electricity for light, heat and power, manufacturers of and dealers in all apparatus and appliances used in connection with the generation, accumulation, distribution and use of electricity, &c. The first subscribers (each with one share) are:—J. Richardson, College Hill Chambers, E.C., secretary; C. O. Battine, College Hill Chambers, E.C., clerk; H. Elliott, College Hill Chambers, E.C., chartered accountant; T. B. Sayer, 51, Coleman Street, E.C., surveyor; C. Connor, 29, Tredegar Square, Bow, E., engineer; A. M. Parratt, The Oaks, Half Moon Lane, Herne Hill, S.E., articled clerk; and R. E. Hookey, Gresham Lodge, Streatham Common, S.W., surveyor. No initial public issue. The number of directors is not to be less than three or more than five; the subscribers are to appoint the first; qualification, £50; remuneration, £50 each per annum and a share in the profits. Registered office, College Hill Chambers, E.C.

Robert H. Edgar, Ltd. (90,012).—This company was registered on August 30th, with a capital of £5,000 in £1 shares, to acquire the business carried on at 128, George Street, Croydon, by R. H. Edgar and H. Roberts, to adopt an agreement with the said vendors, and to carry on the business of electrical and mechanical engineers, manufacturers of and dealers in electric, magnetic, telegraphic, telephonic, photographic and other appliances and apparatus, &c. The first subscribers (each with one share) are:—R. H. Edgar, Newick, Sussex, electrician; H. Roberts, Wallington, Surrey, accountant; N. Snell, "Northcote," Anglesea Road, Ipswich, dental surgeon; A. Snell, Radland, Waldens Park Road, Woking, electrician; Mrs. E. M. Snell, "Northcote," Anglesea Road, Ipswich; H. S. Gotelee, 22, Anglesea Road, Ipswich, managing clerk; and B. Horn, 12, Gainsborough Street, Sudbury, Suffolk, engineer. No initial public issue. The number of directors is not to be less than three or more than seven; the first are R. H. Edgar, H. Roberts, N. Snell and A. Snell; qualification, £100; remuneration as fixed by the company. Registered office, Stanley House, Eldon Park, Norwood, Surrey.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

F. W. Dickinson, Ltd. (electrical engineers, Leeds), (84,249).—A memorandum of satisfaction in full of a debenture dated April 4th, 1906, securing £100, has been notified. £900 7½ per cent. mortgage debentures, created August 17th and dated August 20th, 1906, charged on the company's undertaking and property, present and future, including uncalled capital, have also been registered. No trustees.

THE ELECTRICAL FROISSART CHRONICLES.

(With some apologies to Sir John, and more to "F. C. G.")

By IBID.

IX.—Of Standards.

When the week cometh that is called Summer, are the stretes of Elsecia deserted save by the travelers from other countries. For so chepe is now become all travel that there were soon no work for the geographer, if it were not that those who inhabit a countrie know it not at all. Howbeit, the Yengees, Franks and Allemaynish people have yet some trouble to come through the maze of stretes, by reason that they cannot find one speaking Englysshe to direct them in the way. Those that would come at the house of the Electriks, or of the Ascetiks, or to the meeting of Plates and Rolls are often put to confusion and certain delay for this reason. Wherefore, the better to show and direct these people, are flags displayed, called standards, on the outer walls of the chief castles. Where these are also will be found certain very comely and courteous persons anxious to set the strangers in the right way. And within is a cheerful sound of the musick of many trumpets.

Now this displaying of standards hath become a custom with small and great; so that, by reason of their multitude, the intent or use of them was almost entirely lost; and many curious flags and horrid devices were shown, to the grievous troubling of the Heralds and other learned folk; so that these and others made a comité or conference to direct the fashion of these standards, that all be seemly and in good order. Very grete good was effected in this manner, and now ye shall seldom see such devices as three flies in a horn of mead, to signify patience under adversity; or a national flag inverted on a ground various, with the motto, "Any country but my own," signifying a confusion of ideas. Having brought things to this state in a short period, the comité took counsel, seeing that it is contrary to precedent that a commission or other learned body cease from its labours until that whereon it sitteth is altogether worn-out and obsolete; so they cast about for something wherewith to fill their offis for a decent space of time. Marking particularly how many tunes were blown on the trumpets of the musickers, they would show them that it were better for the ears of those that listen, and the pens of those that write, that all should blow in the same tune; and this to the bettering of harmonie. (So that, by use of a code-word, as "Hiawatha," one may be sure of having always the same musick.) Some, indeed, took the thing well, and did attune their humming machines to the notes of the comité; but others objected that, by adjusting their Rolls to these bars, it ran hard but they should spoil their Billets; and the more, that in the making of magick (to wit, Electriss) it is not possible to avoid a constant changing or alternation; also, that such things lead to socialisms, and an equality of screws. Howbeit, that comité is not so easily frightened; so that they have drawn many under their standards; and this same device hath done much for the science of small arms. It is to be hoped that, when they proceed further, a man may buy him armour knowing that the same is lined with good cow-hide and nothing less, to the comfort of those that deplore the softness and flabbiness of the age.

Nevertheless, the danger of this standarding is in the increase thereof; for the Englysshe are already so averse to have change, that if ye present to a merchant a bill of fifty florins, hardly will he render you the same in metal; and, without that they all know it, they have a very grete hatred of that which is new. In this idea, it may well happen that they will presently decree that what is, is; and it were a pity to alter it. By this doctrine do many ancient machines to this day make grete waste of charcoal, and already they would restrain the carriage which is called motor because, forsooth, it moveth; and many speak evil of those which the Electriks made for the Count of London, though, I think, not for the same reason.

To any that will consider thereon, the matter is very plain, that, where any change is directed and authorised by a just and wise prince, such as the Count of London, it is necessary and of good intent; and it is a very suitable and pleasant ordinance that the inferior people shall pay mult and tax for the purpose; but a body of persons (even though they be all head) not nobly born, through dissension among themselves, cannot come to good end without a leader; and so would fix everything where it is, and taille it to a sameness easy of recognition, to the destruction of all reasonable advancement, and the lessening of courtly striving and competitions.

ELECTRICITY SUPPLY ACCOUNTS.

Glasgow Municipal Electricity Supply.

The returns of this undertaking for year ending May 31st last might, at first glance, indicate a falling away from the high standard to which we are accustomed. For although the sales of energy continue to increase at a normal rate, the figures for the last three years being:—1906, 21½; 1905, 18¼; and 1904, 15 million units respectively, the reduced tariffs now in force are estimated to have denuded the department's revenue account for the year of some £19,000. Unfortunately the costs of generation and distribution are also on a higher scale than the preceding year, due to the increased cost of coal, to a general overhaul of buildings, plant, and mains, and to increased rates and taxes.

However, the department actually earned a gross revenue £9,500 in advance of the previous year, and after meeting interest and sinking fund charges there still remained some £42,000 balance with which to provide for depreciation on the usual liberal scale adopted by the department; after meeting these charges a surplus of £3,808 remained, which was transferred to the reserve fund account, which latter now totals £16,913.

The prices charged are:—Private lighting, 3½d. to 1d. per unit, maximum demand and flat rates; 100-volt supply 8d. per unit; power, 1½d. to ¾d. per unit. The chief engineer is Mr. W. W. Lackie.

General Statement.

For year ending May 31st ...	1906.	1905.
Total capital expended	£1,368,134	£1,244,163
Number of units sold—		
Private supply	19,921,162	16,642,253
Public lighting	1,525,505	1,525,505
Traction	89,758	80,710
Total number of units sold ...	21,536,425	18,248,468
Equiv. No. of 8-C.P. lamps connected ...	1,157,347	981,230
No. and H.P. of motors connected ...	2,595 = 11,954	2,081 = 9,366
Number of public lamps	825	825
Maximum load in KW.	16,304	13,437
Revenue account—		
Gross revenue	£195,842	£186,371
„ expenditure	£91,416	£71,721
„ profit	£104,426	£114,650
Average inclusive price obtained per unit—		
Private supply	2·19d.	2·5d.
Public lighting	1·93d.	1·95d.

Revenue Account for 1906.

Gross revenue...	£195,842 =	2·18d. per unit.
Works and distribution costs (inc. pub. ltg.)	£61,022 =	·67d. „
Total working costs	£91,416 =	1·018d. „

Profit Statement, 1906.

Interest on loans	£42,486
Sinking fund	20,142
Depreciation	37,990
Surplus on year's working	3,808
Gross profit	£104,426

Turning to the reduced tariffs in force the average price obtained per unit during the past year was 2·18d., a decrease of ·28d. on the year before; the generating costs per unit sold for the same periods were:—

	1905.	1906
Coal costs, &c., including energy supplied by tramways department	·496d.	·507d
Distribution	·124d.	·132d.
Public lighting	·046d.	·039d.
Rent, rates and taxes	·182d.	·236d.
Management	·094d.	·102d.
*Special charges	·038d.	—
Total	·960d.	1·02d.

* The special charges during 1905 related to the changing of consumers' pressures.

From the E.L. Committee's report we gather that the total number of consumers during the respective years was (1906) 13,705; (1905) 11,643; 2,595 motors of 11,954 H.P. were supplied as compared with 2,081 motors of 9,366 H.P. in 1905.

The number of units consumed for power purposes was 6,575,496, of which 3,493,839 were sold at 1½d. per unit, 382,875 at 1d., and 2,698,782 at ¾d. per unit. The number of street arc lamps in use remained stationary at 825.

The report concludes with references to the installation of 4,500 H.P. turbo-generators and subsidiary plant at the Port-Dundas and Pollokshaws power stations; the extensions of motor-generator plant, &c., at the Waterloo Street, Dalmarnock, Cathedral Street, and Springburn sub-stations.

The Dalmarnock sub-station is supplied by the Tramways Department at present; that department sold 1,406,243 units to the Electricity Department during 1906, as compared with 1,243,532 units in 1905.

CITY NOTES.

Mersey Railway Co.

Mr. James Falconer (chairman) presided on Thursday last week at Worcester House, over the half-yearly ordinary general meeting of this company.

In moving the adoption of the report (see Electrical Review, p. 349), the Chairman said he was glad to be able to say that it showed substantial improvement in the position of the company in every respect. The number of passengers, as compared with the corresponding period of last year, had increased by practically half-a-million, and the receipts from passengers had increased by £2,604. As regarded the passengers, the improvement had taken place in both classes at every station, and both as regarded the local and the through passengers, and this also applied to the receipts. It was particularly gratifying that they should now be realising to some extent the benefit of the re-arrangement of their fares which took place two years ago. Not only was there an increase in their receipts, but the ratio of increase doing the half-year would be better than it had been in any half-year, except in the half-year which immediately followed the electrification of the line. The total increase of revenue from all sources during the half-year, was £3,592, and this compared with an increase of £1,994 in the preceding half-year; an increase of £2,286 in the half-year before them, and of £4,248 in the half-year which followed the electrification. The increase had been maintained since the close of the accounts up to June 30th. They might, therefore, infer that a steady development was taking place in the traffic. If they compared the results with the returns for the half-year immediately preceding the electrification, the results were very striking. The number of passengers had increased by 2½ millions, or 88 per cent. over those carried in the half-year ending December 31st, 1902, while the receipts had increased by £14,190, or 59 per cent. These results showed that the policy which had been adopted by the company to provide the best possible services between Liverpool and Birkenhead and the adjoining districts at reasonable fares, had been justified. As a matter of fact, it also showed that the sources of traffic between the congested city of Liverpool and the residential districts of Cheshire were practically unlimited, and depended only on the sufficiency of the accommodation given to the public. He need hardly say that the board intended to continue the policy of doing everything in their power within reason to provide the best possible service for the public which the great undertaking they were in charge of was capable of providing. It was in pursuance of that policy that they resolved to supplement the existing means of collecting and dispatching traffic on the Cheshire side by establishing a service of motor-'buses in districts not adequately served by railways or tramways. They acquired the 'buses and commenced the service, but the Corporation of Birkenhead took proceedings against them in court, with the result that an injunction was granted against the company. At the same time they applied to Parliament for power to run 'buses, and after very careful consideration, the Committee of the House of Lords passed the Bill. In the House of Commons, however, the Corporation of Birkenhead took the unusual course of opposing on second reading, and the clause was defeated. He ventured to say that the interests of the public ought not to be set aside for the protection of the vested interests of the Corporation in their ferry boats and tramways. At the same time, he did not agree that an extension of the travelling facilities would reduce the net revenue of the Corporation tramways; but even if it did for a short time, the question was, "Is it worth while to check the development of Birkenhead merely for the sake of preventing some slight deficit on the tramways?" He was not without hope that before long the public convenience would result in their getting the powers they asked for. Their new plant had been doing its work most efficiently, and they had not had anything which might be called a hitch. When he recalled the days when they proposed to embark on electric traction, and the numerous difficulties and risks which were placed before them by those who were in favour of the continuance of steam, he was bound to say it was a great gratification to find not only that the change had taken place, but that it had given them a plant upon which they could absolutely rely.

The report was adopted.

The London Electrobus Co., Ltd.

Several of the daily papers have published reports of the statutory meeting of this company, held at the Hotel Cecil on August 29th, when "all the directors were present to meet a large number of shareholders." From this report (which the *Financial News* is careful to point out "*has been supplied to us*") we gather that Mr. J. T. Musgrave, the chairman, stated that satisfactory progress was being made towards placing a line of electric 'buses on the streets. Notwithstanding the large number of withdrawals, there still remained on the book of the company nearly 50,000 shares, in respect of which only £170 was owing for calls made. This fact proved that the present shareholders were in accord with the directors on the question of the future of the electric 'bus. Thirty vehicles were on order, ten of which were being pushed forward rapidly, and the public would soon be able to form their own opinions as to the advantages of the electrobus. Satisfactory contracts had been entered into for tires and accumulators, and they already had a suitable garage. Despite all the hostility the company had met, the board had even more confidence in the project than at the time when the company's prospectus was published.

Mr. Beechcroft (a director) stated that the fact of the directors meeting their shareholders was sufficient answer to the criticisms that had been levelled at the company and its officials. Some of the contracts had been amended, greatly to the advantage of the shareholders. Speaking as regards the technical criticisms that had been made, he asserted that experts' opinions varied just as much on electrical as on medical matters.

Perth Electric Tramways, Ltd.—An interim report to the shareholders shows that the income and operating expenses for the six months to June 30th, 1906, were as follows:—Income for half-year, 1906, £39,273; 1905, £36,614; increase, £2,659. Expenses for half-year, 1906, £19,694; 1905, £20,143; decrease, £449. Thus the profits for the half-year to June 30th, 1906, are £3,108 greater than for the corresponding period of last year. Since June 30th, the traffic receipts have shown an increase each week over the corresponding week in the previous year—the total increase for the eight weeks ended 24th ult. (as advised by cablegram) being £699.

South Metropolitan Electric Light and Power Co., Ltd.—Warrants for dividend for the half-year ended June 30th last on the 7 per cent. cumulative preference shares of this company were posted to the respective shareholders on the 30th ult.

MARKET QUOTATIONS.

Wednesday, September 5th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a ,, ,,	per ton	£30	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£15	..
a Benzole (90 %)	per gal.	10½d.	..
a ,, (50 %)	per gal.	10d.	..
a Copper Sulphate	per ton	£26	..
a Lead, Nitrate	per ton	£28	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90 % at 160° C)	per gal.	5/6	..
a Potassium Bichromate, in casks	per lb.	3½d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a Potassium Cyanide	per lb.	7½d.	..
a Shellac	per cwt.	220/-	20/- inc.
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %	per ton	£10 15	..
a ,, Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	2¾d.	..
a ,, Cyanide	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£200	..
b ,, Wire, in ton lots	per ton	£220	..
b ,, Sheet, in ton lots	per ton	£210	..
b Babbitt's metal ingots	per ton	£48 to £140	..
c Brass (rolled metal 2" to 12") basis	per lb.	9d.	..
c ,, Tube (brazed)	per lb.	10¾d.	..
c ,, ,, (solid drawn)	per lb.	9¾d.	..
c ,, Wire, basis	per lb.	9¼d.	..
c Copper Tubes (brazed)	per lb.	1/0½	¼d. inc.
c ,, ,, (solid drawn)	per lb.	1/0½	¼d. inc.
g Copper Bars (best selected)	per ton	£99	£2 inc.
g Copper Sheet	per ton	£99	£2 inc.
g ,, Rod	per ton	£99	£2 inc.
c ,, (Electrolytic) Bars	per ton	£92	..
c ,, ,, Sheets	per ton	£104	..
c ,, ,, Rod	per ton	£95	..
c ,, ,, H.C. Wire	per lb.	11d.	..
f Ebonite Rod	per lb.	8/3	..
,, Sheet	per lb.	8/-	..
n German Silver Wire	per lb.	1/7	..
h Gutta-percha, fine	per lb.	6/- to 7/-	..
h India-rubber, Para fine	per lb.	5/2 to 5/2½	..
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	54/4½	9d. inc.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8	per ton	£9 15	..
g Lead, English Ingot	per ton	£18 2 6 to £18 5	15/- inc.
g ,, ,, Sheet	per ton	£20 2 6 to £20 5	15/- inc.
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£7	..
d Mica (in original cases) small	per lb.	6d. to 1/-	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/8	..
p ,, rolled bars & rods	per lb.	1/1½ to 1/8	..
p ,, ,, strip & sheet	per lb.	1/4	..
o Platinum	per oz.	nominal	..
e Silicium Bronze Wire	per lb.	1/- to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
,, ,, in bars		£15 to £40	..
g Tin, Block (English)	per ton	£183 10 to £184 10	10/- inc.
n ,, Wire, Nos. 1 to 16	per lb.	2/3	1d. inc.
p White Anti-friction Metals— "White Ant" brand	per ton	£46 to £70	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£32	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

Gold Coast.—The Colonial Secretary of the Gold Coast reports that on December 31st last, there were 40 telegraph offices open to the public in the Colony, Ashanti and the Northern Territories with a total constructed length of line of 1,078 miles. The total number of telegrams dealt with was 193,877, as compared with 270,518 in 1904. This is accounted for chiefly by the decrease in the number of official telegrams, which amounted to 62,990, as compared with 104,040 in the previous year.

STOCKS AND SHARES.

Tuesday Evening.

Our story this week is illumined with continued brightness in electricity supply issues. That is the main feature. The amount of investment business being done is small because of the comparative dulness in the Consol market due to the monetary situation. Home Railway stocks are depressed on account of imagined troubles to come with employés. In the Telegraph and Manufacturing lists occur few changes of moment, but the Traction department is better, on the whole.

Fervent heat seems to agree with electricity supply shares; it expands prices in an upward direction. County of London Ordinary have secured the principal improvement, a rise of ⅜, making the price 9½. Advances of ¼ have brought St. James' Preference to 7½, South Londons to 3½, Chelseas to 5⅜, Bromptons to 8¾, and City Preference to 12. London Preference at 5½ have recovered their deducted dividend of 3s. a share, and there are sundry rises of 2s. 6d. in the list, while the Debenture issues are better here and there.

This change of position is certainly due to a better recognition of the unduly low levels to which these supply shares had dropped. The advertising, to which reference was made here last week, has fulfilled its mission to admiration, but the source of inspiration raises a shadow of doubt as to the real reason for the direction of public attention to a particular group of shares in this section. However, we should be the last to quarrel with such means for securing a wider public acquaintance with the market, which contains sound shares of an investment character that deserve to stand at enhanced values.

Weakness in Home Railway stocks generally is the primary cause of a fresh fall in Metropolitan Consolidated to 64, bargains having been done even lower than this. The refusal of the company to advance its whole list of fares seems to be resented, and, curiously enough, Districts are a little harder at 23½. The Baker Street and Waterloo line should be reaping harvests from this torrid weather, the atmosphere being deliciously cool on the hottest days, but the company's debenture stock sticks at 90, a figure easily surpassed last week-end by any shilling thermometer. Great Northern, Piccadilly and Brompton Debenture is 87½, but Charing Cross, Euston and Hampstead Debenture stands a point higher. It is to be noticed that the "Bakerloo" comes into working connection with several important feeders this month, which should stimulate its traffics considerably.

Amongst traction shares, Calcutta Trams are the most buoyant, the old rising ⅝ to 8⅝, and the new ¼ to 8⅜, Anglo-Argentine new are ⅛ up at 7¼, and the forthcoming dividend announcement is awaited with keen interest. British Columbia Preference and Debentures have strengthened, and both the British Electric Traction Debenture stocks are up a point. But Potteries Ordinary has declined to 7, and Cape Electrics at 12s. 6d. are 2s. 6d. lower, having retained briefly the rise they made on account of the boomlet in the Kaffir market. British Thomson-Houston Debenture at 96 and Brush first Debenture at 97—both are 4½ per cent. securities — have recovered part of the interest just paid. Kalgoorlie Electric "B" Debenture has lost 3 points at 84½.

About telegraphs there is really very little to say. Direct United States Cable shares are ¼ lower, and Anglo-Americans follow a similar line; the "A" stock continues to dodge about in price in its own particular way. The Eastern group has no change to call for mention, and the shares of the companies serving the West Indies are also motionless. West African Telegraph shares are up 5s. Globe Telegraph and Trust Ordinary at 11 have added ⅛ to their price. Telephone issues are ⅛ rise in National Preferred and Deferred, and the return to peace in distressed Chili has raised the price of Chili Telephones to 6½, which is 2s. 6d. better.

Henley's Ordinary shares at 12⅛ are *ex* 5s. dividend, which the price has recovered. The Preference at 5⅜ are *ex* 2s. 3d. Both classes of the company's Debenture stock have risen a little. Babcock & Wilcox are again firmer at 4⅜, a rise of 5s., there being a steady and increasing demand for shares of this industrial class. Another sort of investment now to the front is the alkali trade. Castner-Kellner Debenture has advanced 2, but the shares remain about 22s. Crompton's at 35s. are a trifle easier.

Telegraphs in Manchuria.—The Japanese Government officially announces that on 1st inst. the following offices were again opened for the receipt of public traffic, viz.:—Rijojunks (Port Arthur), Dairen (Dalny), Ancoken (Antung), Eiko (Yingkow), Lyoys (Laoiane), Hoten (Mookden), Shimminfu (Sinomingfu), and Tetsurei (Tieling).

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations Aug. 28th.	Closing Quotations Sept. 4th.	Business done week ended Sept. 4th, 1906. Highest.	Lowest.	Rise + or Fall —
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3¼ — 4	3¼ — 4	..	..	..
155,600£	Do. do. 5 % Debs., Nos. 1 to 1,950 Red.	100	Nil	Nil	Nil	5 %	87 — 92	87 — 92	89	..	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	2¾%	3¼%	66 — 68	66 — 68	66⅞	..	..
8,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6¼ %	6 %	113¼—114½	114 —115	114⅝	114	+ ⅛
8,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	⅛%	24½ — 24¾	23⅝ — 23⅞	24 1/16	23⅝	— ⅛
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	101 —103	99 —101 xd	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	8 %	6½ — 6⅝	6½ — 6⅝	6⅝	6½	+ ⅛
1,982,856£	Commercial Cable Stlng. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	97½ — 99½	97½ — 99½	98½	97½	..
16,000	Cuba Telegraph	10	6¼%	10 %	5 %	5 %	8½ — 9	8½ — 9	..	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18	17 — 18	..	..	..
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜ — 3⅝	3⅜ — 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8¾ — 9¼	8¾ — 9¼	..	..	..
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..
60,710£	Direct United States Cable	20	3½%	3 %	3½%	4½%	15½ — 16	15½ — 15¾	17⅜	15⅜	— ⅛
65,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,300,R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	144 —147	144 —147	145½	145	..
2,000,000	Do. 5½ % Pref. Stock	100	5½%	5½%	5½%	5½%	90 — 92	90 — 92	92	..	..
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	107 —109	107 —109	107½	107⅜	..
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	14½ — 14⅝	14½ — 14⅝	14 1/16	14 1/16	..
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	105 —107	105 —107	105⅜	..	..
300,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
180,887	Globe Telegraph and Trust	10	£3	5½%	5⅝%	5¾%	10⅜ — 11 xd	10⅞ — 11⅛	11 1/16	10 13/16	+ ⅛
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅝ — 14⅞ xd	14⅜ — 14⅝	14⅝	14½	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	37½ — 39½	37½ — 39½	38⅝	..	..
37,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	13 %	58 — 60	58 — 60	60	..	..
251,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	⅝ — 1 3/16	⅝ — 1 3/16	21/3	..	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	8 %	3 %	4 %	..	⅞ — 1 1/16	⅞ — 1	..	..	— 1/16
56,492	Do. do. do. 5 % Pref.	1	5 %	5 %	5 %	..	1 — 1	1 — 1 1/16	..	..	+ 1/16
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	108½—110½	109 —111	110⅝	109⅜	+ ⅜
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	108½—110½	109 —111	110⅜	109⅛	+ ⅜
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	11 — 13	11 — 13	..	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10½ — 12½	10½ — 12½	..	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅝ — 5 13/16	5⅝ — 5⅝	5 13/16	5⅝	+ 1/16
2,000,000	Do. do. 5½ % Deb. Stock Red. ..	Stock	5½%	5½%	5½%	5½%	98 —100	98 —100	98¼	..	..
1,689,593	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102¼—104½	102¼—104½	104½	103½	..
179,313	Oriental Telep. and Elec. 1 to 171,504,fully paid	1	6 %	6¼%	6¼%	7½%	1 1/16 — 1 1/16	1 1/16 — 1 1/16	..	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1 1/16 — 1 1/16	1 1/16 — 1 1/16	..	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	97 — 99	97 — 99	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
11,839£	Reuter's	8	5 %	5 %	5 %	5 %	7¼ — 7¾	7¼ — 7¾	..	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½%	101 —104	101 —104	..	..	..
3,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	129 —132	129 —132	..	..	..
70,000	United River Plate Telephone	5	7 %	8 %	8 %	8 %	7 — 7¼	7 — 7¼	7 5/16	7⅛	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5¼ — 5½	5¼ — 5½	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	109 —112	109 —112	..	..	..
15,609£	West African Telegraph, Shares	10	2½	4 %	4½%	4 %	9¾ — 10	9¾ — 10	..	..	..
30,008	W. Coast of America, 1 to 30,000 & 58,001 to 58,008	½	Nil	Nil	Nil	Nil	⅞ — ⅞	⅞ — ⅞	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4 %	4 %	4 %	4 %	100¾ — 103½	100¾ —103⅝	..	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	5 %	14¼ — 14⅝	14¼ — 14⅝	14⅝	14⅜	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	.. ..	.. ..	..	..	..
563,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 —106	103 —106	104½	..	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅜ — ½	⅜ — ½	..	..	..
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %*	7 %*	6 %	5 %	6¼ — 6⅝	6¼ — 6⅝	6⅝	6½	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	4¾ — 5¼	4¾ — 5¼	..	..	..
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	99 —102	99 —102	..	..	..

Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

730,000	Anglo-Argentine Trams, 280,008 to 480,007	5	..	..	8 %	8 %	7⅞ — 7⅞	7 15/16 — 7 15/16	7⅞	..	+ 1/16
100,000	Do. Nos. 430,008 to 910,007 and 560,008 to 580,007 ..	5	..	..	..	..	7 1/16 — 7 1/16	7 1/16 — 7 1/16	7 1/16	7⅛	+ ⅛
260,007	Do. 5½ % Cum. Pref., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5⅜ — 5½	5⅜ — 5½	5 3/32	5 1/16	..
265,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	138 —141	138 —141	..	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	102 —104	102 —104	103⅜	103½	..
800,000	Babcock & Wilcox, 1 to 800,000	1	..	17 %	20 %	20 %	4 — 4¼	4¼ — 4⅜	88/1½	85/-	+ ⅛
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..
38,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	7 %	7 %	3¾ — 4	3¾ — 4	78/1⅛	..	..
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	7 %	7 %	6⅜ — 6⅝	6⅜ — 6⅝	6 1/16	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5 — 5½	5 — 5½	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	4 %	4 %	4 — 4¼	4 — 4¼	..	..	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	101 —105	101 —105	..	..	..
300,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	6 %	117 —120	117 —120	..	..	..
300,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	110 —113	110 —113	..	..	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	105 —108	106 —109	..	..	+ 1
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	103 —105	103½ —105½	104⅞	..	+ ½
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
133,301	British Electric Traction	10	8 %	6 %	6 %	3 %	5¾ — 6	5¾ — 6	5 13/16	5 11/16	..
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	9½ — 10 xd	9½ — 10	9 13/16	9 11/16	..
1,416,422£	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	113 —116	114 —117	116⅛	114⅛	+ 1
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	91 — 94	92 — 95	94	..	+ 1
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6¾ — 7¼	6¾ — 7¼	..	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5¾ — 6	5¾ — 6	..	..	..
600,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	96 — 98	97 —100	..	..	+ 1½
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1½ — 1⅝	1½ — 1⅝	31/3	..	..
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	77 — 83	77 — 83	..	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	11/16 — 1 1/16	11/16 — 1 1/16	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	2½%	⅞ — 1⅛	⅞ — 1⅛	..	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	6 %	1⅝ — 2	1⅝ — 2	34/4⅓	..	..
125,000£	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	97 — 99	96 — 98 xd	..	..	..
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	82 — 84	82 — 84	82½	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	3⅜ — 3⅝	3⅜ — 3⅝	71/3	..	..
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5¼ — 5⅝	6¼ — 5½	..	..	..
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	5 — 5½	5 — 5½	5⅛	..	..
817,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	104 —106	104 —106	..	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 —105	102 —106	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	8 %	8 — 8¼	8⅛ — 8⅜	8 1/16	..	+ ⅛
32,610	Do. 105,001 to 137,610	5	..	..	..	8 %	7⅞ — 8⅛	8¼ — 8⅜	..	..	+ ⅛
350,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4½%	4½%	103 —106	103 —106	..	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	15%	10⅜ — 11⅛	10⅜ — 11⅛	..	..	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	..	..	..
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108 —110	108 —110	..	..	..
491,223	Cape E. Trams., 1 to 491,223	1	..	15 %	10 %	6 %§	⅜ — ⅞	⅜ — ⅜	12/6	..	— ⅛
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	6 %§	1 3/32 — 1 5/32	1 3/32 — 1 5/32	2/7-	21/6	..
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	95 —100	97 —102	..	..	+ 2
1,939,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87 xd	85 — 87	86⅛	85½	..
630,316	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	97 — 99 xd	97 — 99	98⅜	..	..
630,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	73 — 76	73 — 76	..	..	..
480,000	City and South London Railway	Stock	3½%	2½%	2½%	1¾%	45 — 47	44 — 46	..	..	..
85,000	Crompton & Co., Nos. 1 to 85,000	£	5 %	2½%	2½%	2¾%	1 1/16 — 1 1/8 xd	1⅛ — 1⅛	36/10½	..	— 1/16
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	95 — 98	95 — 98	..	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued)*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME,	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations Aug. 28th.	Closing Quotations Sept. 4th.	Business done week ended Sept. 4th, 1906. Highest	Lowest.	Rise + or Fall—
260,000	Dick, Kerr & Co., 1 to 260,000	† 1	..	..	10 %	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	..	6 %	6 %	6 %	1⅝ — 1⅞	1⅝ — 1⅞	..	..	..
234,150	Do. do. 4½ % Deb. Stock	100	..	4½ %	4½ %	4½ %	103 —106	103 —106	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5½ %	6 %	6 %	14 — 15	14 — 15	..	..	..
59,987	Do. 6% Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14 — 15	14 — 15	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	Nil	5/16 %	..	1¼ — 1⅜	1⅜ — 1⅝	32/6	..	..
17,139	Do. "A" shares, 01—017,139	5	Nil	Nil	2½ %	..	2½ — 3	2½ — 3	..	..	..
844,023	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..
100,000	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	Nil	⅛ — ¼	⅛ — ¼	..	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	7 %	7 %	7 %	7 %	1⅞ — 2⅛	1⅞ — 2⅛	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	86 — 89	85 — 88	..	..	−1
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	9 — 9½	9 — 9¼	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	93 — 97	93 — 97	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %	3½ — 4	3½ — 4	75/-	74/4½	..
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10½ — 10¾	10¾ — 10¾	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	101 —102	100 —102	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	15%	12 — 13	12 — 13 xd	..	..	..
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5⅜ — 5⅝	5½ — 5¾xd	5⅝	..	..
41,578	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	107 —109	107½ —108½	108¾	..	+ ⅛
108,022	Do. do. Scrip. All paid	..	..	..	..	..	107 —109	107½ —109½	..	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works.	10	10 %	10%	5 %	10%	17 — 18	17 — 18	..	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	12½%	12½%	12½%	Nil	1 5/16 — 1 7/16	1 5/16 — 1 7/16	..	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	4½ — 6½	4½ — 6½	..	..	..
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	3 %	8 — 8½	8 — 8½	..	..	..
899,930	Do. do. 60,008 to 100,000 (£6 paid)	10	..	8 %	6 %	3 %	3½ — 4½	3½ — 4½	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	8½ — 9½	8½ — 9½	..	..	..
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	94 — 97	94 — 97	94½	94	..
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	3 %	3/16 — 5/16	3/16 — 5/16	2/6	..	..
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/16 — 1/8	1/16 — 1/8	17/-	..	..
350,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	100 —102	98½ —100½	..	..	−1½
20,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	5	..	..	6 %	6 %	4½ — 5½	4½ — 5½	..	..	..
24,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	4 %	6½ — 7½	6½ — 7½	..	..	−¼
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	7½ — 8½	7½ — 8½	..	..	..
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	100 —103	100 —103	..	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	15 %	33½ — 35½	33½ — 35½	..	..	..
150,000	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	4 %	90 — 92	90 — 92	..	..	..
540,000	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	3½%	101 —104	101 —104	..	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	8½%	3 %	Nil	Nil	3/4 — 1¼	3/4 — 1¼	..	..	..
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	Nil	Nil	2¾ — 3¼	2¾ — 3¼	..	..	..
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	77 — 82	77 — 82	..	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5⅛%	4 %§	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	10 %	8 — 9xd	8½ — 9	8⅝	..	+ ⅛
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7½ — 8xd	7⅞ — 8	..	..	−1
300,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	101 —104	100 —103	..	..	−⅛
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %	4½ — 5xd	4 — 5	..	..	+ ⅛
80,000	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4⅜ — 4⅝xd	4½ — 5	..	..	..
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	4 — 4½	4 — 4½	82/6	..	..
40,000	Do. do. 1903	5	..	4½%	4½%	4½%	4 — 4½	4 — 4½	..	..	..
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —104	101 —104	103½	102	..
44,436	Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	6 %	5½ — 5⅝	5½ — 6	..	..	+ ⅛
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106 —108	106 —108	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	10⅜ — 11¼	10⅞ — 11⅛	11¼	11	+ ⅛
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	12 — 13	12 — 13	..	..	..
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	..	..	..
300,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	100 —103	101 —104	..	..	+1
40,000	County of Durham Electrical Power, Ord.	2	4 %	4 %	£3 7 0	4 %	2 1/16 — 3 1/16	2 1/16 — 3 1/16	..	..	..
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	5 %	8⅛ — 9 xd	8⅞ — 9⅛	9 3/16	8 15/16	+ ⅛
80,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	11½ — 12½xd	11½ — 12½	12⅛	11 15/16	..
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	107 —110	107 —110	..	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	4 %	3½ — 3¾	3⅜ — 3⅝	..	..	+ ⅛
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 %	4⅝ — 5⅜	4⅝ — 5⅜	5 5/16	5	..
820,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	5½%	5½%	100 —103	100 —103	..	..	..
10,000	Folkestone, 1 to 10,000	5	..	5½%	5½%	5½%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	5 — 5⅛	5 — 5⅛	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	99 —102	99 —102	..	..	..
13,000	Hove, 1 to 13,000	5	..	8½%	8½%	9 %	7⅜ — 8⅛	7⅜ — 8⅛	..	..	+ ⅛
10,000	Do. New (£6 10s. paid)	£3	..	8½%	8½%	9 %	6⅝ — 7	6⅝ — 6⅞	..	..	− ⅛
87,303	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	99 —101	99 —101	..	..	..
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	99 —101	99 —101	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12½	12 %	10 %	9⅞ — 10⅜	9⅞ — 10⅜	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	4 %	1⅞ — 2⅜	1⅞ — 2⅜	..	..	..
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	5 — 5⅜	5 — 5⅜ xd	5⅜	5	..
874,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8½%	10 %	10 %	8⅜ — 8⅝xd	8⅜ — 9	..	..	+ ⅛
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	4½%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
220,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	109 —113	109 —113	..	..	..
250,000	Do. 3½ % Mort. Deben. Stock Redeem.	Stock	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..
75,000	Newcastle-on-Tyne, 1 to 75,000	5	..	8 %	8 %	8 %	7⅞ — 8	7⅞ — 8	..	..	..
75,000	Do. 5 % Pref., 1 to 75,000	5	..	5%	5 %	5 %	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	7½%	13⅜ — 14½	13¾ — 14⅜	..	..	..
64,000	Do. do. 4 % 1st Mort.Deb.	100	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6½%	7 %	7 %	6⅛ — 6⅞	6⅛ — 6⅞	6½	6 7/16	..
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	98 —100	97 — 99	..	..	−1
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	12½%	10⅜ — 11⅛	10⅜ — 11⅛	..	..	..
20,000	Do. do. 7 % Pref. 20,061 to 40,080	5	7 %	7 %	7 %	7 %	6⅞ — 7⅝	7 — 8	..	..	+ ⅛
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	4 %	2 — 2½	2 — 2½	..	..	..
60,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	74 — 78	74 — 78	..	..	..
65,000	South London Electricity Supply, Ord.	5	12½%	8 %	4 %	4 %	2⅜ — 3⅛	3 — 3⅜	62/6	..	+ ⅛
102,700	South Met. Elec. Lt. & Power (Ord.	1	Nil	Nil	Nil	2½%	1/16 — 3/16	1/16 — 3/16	..	..	..
85,368	*(Late Blackheath and Greenwich* 7 % Pref.	1	Nil	7 %	7 %	7 %	1⅛ — 1⅜	1 1/16 — 1 3/16xd	..	..	..
148,292	*Dist. E.L.Co.)* 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
50,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	3⅜ — 4	3⅜ — 4	..	..	..
80,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4½ — 5	4½ — 5	92/6	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	98 —101	98 —101	1·0	..	..
110,000	Westminster Electric Supply, Ord.	5	12 %	13⅓%	14 %	13 %	9½ — 10⅜x	9½ — 10⅜	10⅜	10	..
28,151	Do do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5½ — 5⅝	5½ — 5⅝	5 7/16	..	..
	(Originally 5 %—Red. to 4½ % from 31st Dec., 1905.										

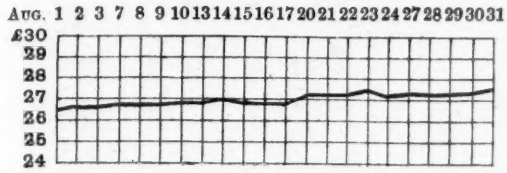
Shares not officially quoted:—Mackay Companies, ord., 75—77. Pref. 75—77.
† Unless otherwise stated all shares are fully paid. § Interim dividends.

(Bank rate of discount 3½ per cent. June 21st, 1906).

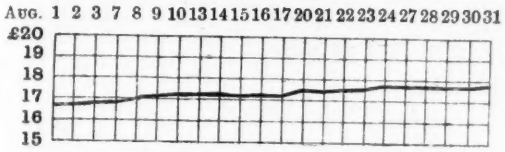
METAL MARKET.

Fluctuations in August.

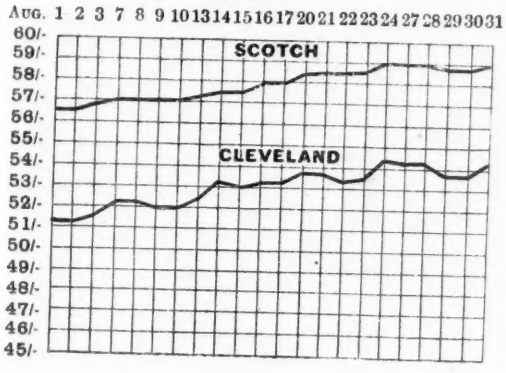
SPELTER (G.O.B's.)



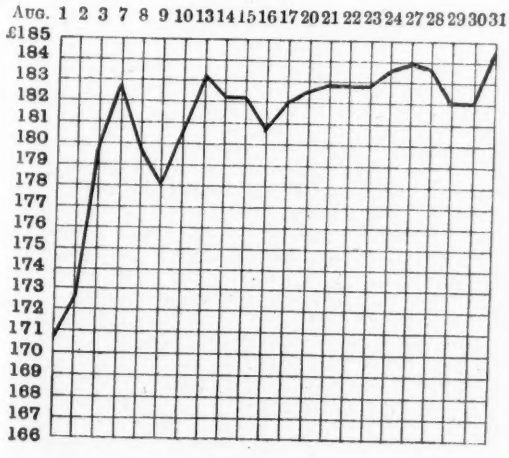
LEAD (ENGLISH)



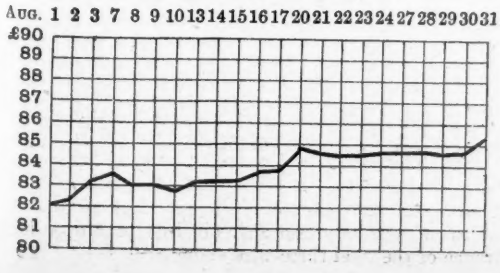
IRON.



TIN.



COPPER (G.M.B's.)



LIMITATIONS OF THREE-WIRE ENERGY MOTOR-METERS.

By H. G. SOLOMON.

(*Concluded from page* 328.)

Alternating-Current System.

When the three-wire network is fed with single-phase alternating current, the results depend not only on the state of balance of the circuits, but also on the power factors of the loads. By the power factor is meant the cosine of the angle by which the current in an outer conductor lags behind or leads in advance of the total three-wire voltage. The meter commonly employed is a single-phase three-wire induction meter. In the single-phase two-wire induction meter the rotation of the armature, which is simply a disk, or bell of copper or aluminium, is produced by the inductive action upon it of two alternating magnetic fluxes due to two electro-magnetic systems, of which the one carries the current flowing in the circuit, and the other is connected across the mains.

Similar to the continuous-current type, which can, of course, be used for alternating currents, provided it contain no iron in either its armature or field system, the three-wire induction meter has only one pressure circuit and two main current coils, of which the one is inserted in the one outer and the second in the other outer main. For a similar reason it also incorrectly registers the energy delivered to the three-wire circuit, unless certain conditions be fulfilled.

Let v_1 and v_2 denote the instantaneous values of the voltages between the outer mains and the neutral wire, v the instantaneous value of the total three-wire pressure, V_1, V_2 and V being the corresponding maximum values; also let c_1 and c_2 represent the instantaneous, and C_1 and C_2 the maximum values of the currents in the two outer mains. When the system is in complete balance and the loads contain neither self-induction nor capacity, *i.e.*, the currents and voltages are all in phase, then—

$$v_1 = v_2 = \tfrac{1}{2} v; \quad c_1 = c_2 = c \text{ (say)}:$$

also $v_1 = V_1 \sin pt$; $v_2 = V_2 \sin pt$; $v = V \sin pt$;

$$c_1 = C_1 \sin pt; \; c_2 = C_2 \sin pt;$$

$$\therefore V_1 = V_2 = \tfrac{1}{2} V, \text{ and } C_1 = C_2 = C \text{ (say)}.$$

Whatever the conditions that prevail, the instantaneous value of the power is—

$$p = c_1 v_1 + c_2 v_2;$$

also $$v = v_1 + v_2.$$

The mean power is

$$P = \frac{1}{T}\int_0^T c_1 v_1 \, dt + \frac{1}{T}\int_0^T c_2 v_2 \, dt. \qquad (4)$$

Since the system is balanced and there is no power factor, it may be easily shown that the mean power is

$$P = \frac{C_1}{\sqrt{2}} \cdot \frac{V_1}{\sqrt{2}} + \frac{C_2}{\sqrt{2}} \cdot \frac{V_2}{\sqrt{2}}$$

$$= \frac{2\,C_1}{\sqrt{2}} \cdot \frac{V_1}{\sqrt{2}} = \frac{2\,C_2}{\sqrt{2}} \cdot \frac{V_2}{\sqrt{2}}$$

$$= \frac{V}{\sqrt{2}} \cdot \frac{C}{\sqrt{2}},$$

where $T = \frac{1}{n} = \frac{2\pi}{p}$, n being the frequency. It is obvious that in this case the meter will read correctly, however its pressure circuit may be energised.

When the system is unbalanced and the pressures are not equal to one another, but the loads are purely non-inductive and have no capacity, then the results already established for a direct-current three-wire system hold, and the meter will read incorrectly whether its pressure circuit be energised by a current proportional to the total three-wire voltage, or the pressure used be that between an outer conductor and the

neutral main. The proof follows in the same manner as for a direct-current system, as the equations in this case hold not only for instantaneous, but also for effective values, there being neither self-induction nor capacity in either of the branches. This latter condition is highly important, as it will be seen from what follows that a very small amount of self-induction considerably modifies the results; moreover, it is one which is very rarely fulfilled in actual practice.

When a phase displacement exists between the pressure and the currents in the two branches, whether the two sides be equally or unequally loaded, the pressures of these two sides will not be in phase with one another.

Referring to fig. 1, O A represents the maximum value V of the total three-wire pressure, O B and O C representing the

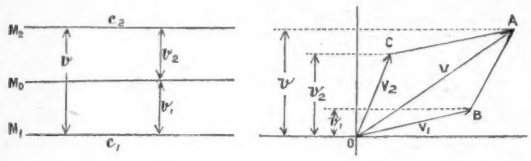


Fig. 1.

maximum values V_1 and V_2 respectively of the voltages between M_1 and the neutral conductor M_0, and M_2 and M_0. Moreover, V_1 lags behind V by some angle A O B $= \alpha$, and V_2 is in advance of V by some angle A O C $= \beta$. Also the current in the outer main M_1 lags by some angle ϕ_1 behind the total three-wire pressure, and ϕ_2 denotes the angle of lag behind V of the current in the second outer conductor M_2. Then quite generally the following relations hold :—

$$v = V \sin pt,$$

$$v_1 = V_1 \sin (pt - \alpha), \; v_2 = V_2 \sin (pt + \beta),$$

$$c_1 = C_1 \sin (pt - \phi_1), \; c_2 = C_2 \sin (pt - \phi_2).$$

Also $$p = v_1 c_1 + v_2 c_2,$$

and $$v = v_1 + v_2.$$

When the system is balanced, in which case the power factor is the same for each side, and the pressures between the outers and the neutral conductor (*i.e.*, maximum or R.M.S. values) are equal to one another, the three-wire meter will only read correctly when its pressure circuit is energised by the total three-wire voltage. If, on the other hand, the pressure circuit of the meter be not connected direct across the two outer mains, but between either outer and the neutral main, then, with the same conditions still obtaining, the meter will read high or low according as the pressure used lags behind or leads in advance of the total three-wire voltage.

Case 1.—The pressure circuit of the meter is energised by a current proportional to the total three-wire voltage.

As the system is balanced, and the pressures, as measured by a voltmeter, are equal to one another, but the current is out of phase with the total voltage, then

$$\phi_1 = \phi_2 = \phi \text{ (say)}; \; \alpha = \beta.$$

Also $$V_1 = V_2,$$

$$\therefore v = V \sin pt, \; v_1 = V_1 \sin (pt - \alpha),$$

$$v_2 = V_2 \sin (pt + \alpha), \; c_1 = c_2 = C \sin (pt - \phi).$$

The instantaneous value of the driving torque on the armature of the meter is proportional to

$$\tfrac{1}{2} v (c_1 + c_2).$$

The mean value of the driving torque can in this case be shown to be proportional to

$$\frac{V}{\sqrt{2}} \cdot \frac{C}{\sqrt{2}} \cos \phi.$$

The energy given by the meter, assuming no errors, is

$$\int_{t_1}^{t_2} \frac{V}{\sqrt{2}} \cdot \frac{C}{\sqrt{2}} \cos \phi \, dt.$$

The instantaneous value of the power absorbed is

$$p = c_1 v_1 + c_2 v_2$$
$$= v \cdot c_1,$$

since $$c_1 = c_2 \text{ and } v_1 + v_2 = v.$$

The mean power is

$$P = \frac{1}{T} \int_0^T v \, c_1 \, dt = \frac{V}{\sqrt{2}} \cdot \frac{C}{\sqrt{2}} \cos \phi,$$

and the true energy is the same as that given by the meter, so that in this case it reads correctly.

Case 2.—The pressure circuit of the meter is energised by a current proportional to the pressure between the main M_1 and the neutral wire $\left(i.e., \text{ by } \frac{V_1}{\sqrt{2}}\right)$; also V_1 *lags* behind V.

As in Case 1 the same conditions obtain as regards the currents and voltages, but the instantaneous value of the driving torque is proportional to

$$v_1 (c_1 + c_2).$$

This reduces to

$$2 \, V_1 \sin (pt - \alpha) \, . \, C \sin (pt - \phi),$$

and the mean value is

$$2 \cdot \frac{V_1}{\sqrt{2}} \cdot \frac{C}{\sqrt{2}} \cdot \cos (\phi - \alpha).$$

The meter reading will thus be

$$2 \cdot \int_{t_1}^{t_2} \frac{V_1}{\sqrt{2}} \cdot \frac{C}{\sqrt{2}} \cos (\phi - \alpha) \, dt.$$

The instantaneous value of the true power absorbed is

$$p = C \sin (pt - \phi) \, . \, \{V_1 \sin (pt - \alpha) + V_1 \sin (pt + \alpha)\}.$$

The mean power is

$$P = \frac{V_1}{\sqrt{2}} \cdot \frac{C}{\sqrt{2}} (\cos \overline{\phi - \alpha} + \cos \overline{\phi + \alpha}).$$

The true energy is the integral of this expression for the power between the times t_1 and t_2.

It becomes

$$E = 2 \int_{t_1}^{t_2} \frac{V_1}{\sqrt{2}} \cdot \frac{C}{\sqrt{2}} \cos (\phi - \alpha) \, dt$$

$$- 2 \int_{t_1}^{t_2} \frac{V_1}{\sqrt{2}} \cdot \frac{C}{\sqrt{2}} \sin \phi \, . \sin \alpha \, dt. \qquad (5)$$

The meter, it will be seen, will read high although the circuits are balanced.

If $\phi = \alpha = 30°$, then the meter reads $33\frac{1}{3}$ per cent. high, and it will read 100 per cent. high when $\phi = \alpha = 45°$.

If the meter be energised by a current proportional to the voltage between the outer main M_2 and the neutral conductor, *i.e.*, by $\frac{V_2}{\sqrt{2}}$, (V_2 *leads* in advance of V), then it can be shown in the same way that the meter reads low. In this case if $\phi = \alpha = 30°$, the meter reads $33\frac{1}{3}$ per cent. low, and when $\phi = \alpha = 45°$ the meter stops, whereas the energy absorbed is

$$\int_{t_1}^{t_2} \frac{V_1}{\sqrt{2}} \cdot \frac{C}{\sqrt{2}} \, dt.$$

When the system is unbalanced and the power factors of the two branches are unequal, the meter will read incorrectly whether its pressure circuit be connected across the two outer conductors or across either outer and the neutral main. The equations become, however, more complicated, and no general results of any value can be deduced from them.

The results which have just been established for Case 2 are for a *lagging* current; they are reversed for a *leading* current. This can be easily verified by substituting $-\phi$ for $+\phi$ in the equations. In other words, with a leading current, the meter will read low or high according as the voltage used to energise its pressure circuit lags behind or leads in advance of the total three-wire voltage.

The energy supplied to a single-phase alternating-current three-wire system may be correctly measured, whatever the conditions that prevail, by means of an ordinary three-phase three-wire induction meter, which is simply a combination of two independent induction motor-meter elements, such as the Westinghouse or Thomson polyphase type. It is important to bear in mind that a three-phase four-wire meter is totally unsuitable for this purpose; further, the ordinary three-wire single-phase induction meter is equally unsuitable for a polyphase system.

Errata.—Two printers' errors found their way into the first instalment of this article, in the second column on p. 327. At the end of line 23, v^2 should be v_2, and at the end of line 43, the word "unequal" should come before the comma. These errors occurred after the final proofs had been passed for the press.

REVIEWS.

Telegraphy. By T. E. Herbert. London: Whittaker and Co. Price 6s. 6d. net.

The need for a thoroughly up-to-date work on practical telegraphy, in view of the considerable changes in method and additional appliances brought into the service of the art in this (and other) countries during the last 10 years or so, is the author's pretext for bringing out this volume. Anyone who has been closely associated with the advances and changes referred to will corroborate the view that a reliable practical work of the kind should be extremely serviceable to all who are connected with telegraphy in this country. In the volume before us there is ample evidence of a very real and conscientious attempt to meet this want. The author is a practical engineer in the service of the Post Office and should therefore be in a position to furnish sound information. The ground covered ranges from elementary principles to complete descriptions of systems, including the new methods of switching telegraph wires through from the station whence a message originates, direct to that for which it is addressed—methods which are now in operation in the London district—and further extensions of which are in course of preparation.

The saving of time and labour involved in retransmission of messages from point to point is the main consideration which has led to the borrowing of this idea from telephone practice. Its application to telegraphy with its varied systems and kinds of apparatus used, and with the varying working voltages required, is not, however, the simple transition that the uninitiated might imagine. True, many of the processes of operation bear a strong similarity to common battery telephone switching systems, but in order to convert the method to telegraphic requirements, many of the details have had to be so profoundly modified as to disguise them almost completely from their original prototype. In this book the system is fully described and illustrated.

The work is confined to the systems of telegraphy used in and by the British Post Office, and does not, therefore, touch methods of submarine telegraphy over long cables. Nor is the subject of wireless telegraphy touched upon, and in this the author shows a wise discretion, as there is already an extensive literature on the subject, though its treatment by practical telegraph engineers is, perhaps, most conspicuous by its absence.

So far as the theoretical parts of the book are concerned, they are throughout of an elementary nature designed for the non-mathematical student, and the whole is put together generally in a terse and lucid manner. There are, however, one or two points in this connection which call for a little criticism. In the first place, the author follows the old practice of giving electrostatics a back seat. After a few introductory phrases the question of flow of current with full descriptions of primary batteries succeeded by discourses on circuits and conductors, and so on, is opened out, and we hear no more of the electric field and electric charges except where it cannot be avoided. In this respect it appears that the work could be made to better fill the bill for the City and Guilds examinations, for which it professes to be carefully adapted. In these days it is generally admitted that electrostatics form an increasingly essential part of the education of a telegraph or telephone engineer, as, indeed, it should do of all electrical engineers, for without the aid of this knowledge insight into many of the laws of electric currents and mutual effects between circuits is necessarily narrow and limited.

Another point. The author has been at particular pains to point out that the self-induction of an iron-cored coil, such as the windings of a relay, varies with the strength of current used, and he insists that such variation is in the direction of *diminishing* the self-induction when this current is increased. In telegraphy, where the saturation point of the iron is mostly or always very remote from the working value, exactly the opposite is the case. The self-induction *increases* very markedly with an increase of current, owing to the increased permeability of the iron in the higher parts of its working range. This is an error which should be deleted in a revision of the book.

A minor fault occurs on page 24, where the porous pot and agglomerate Leclanché cell illustrations have become transposed, accidentally no doubt.

Incidentally there crops up a question of etymology in connection with the plural of the unit of self-induction. The author adheres to the spelling "Henries." In view, however, of the derivation of the word from a proper name the more usual spelling "Henrys" has most supporters, and it would perhaps be well if this way were commonly adopted.

There appears to be little else in the work that calls for comment. It is in the main a well-arranged and practical exposition of the subject, and should prove a useful investment to those who are interested in the practical applications of telegraphy, as well as to the student.

Wireless Telegraphy. By Gustav Eichorn, Ph.D. London: Charles Griffin and Co. Price 8s. 6d. net.

This is not a comprehensive work on wireless telegraphy. It is, in fact, almost the antithesis of a compendium on the subject. It is rather framed to show the way in which the subject has been tackled in Germany, the practical results obtained, and last, but not least, to extol the work of certain German savants, in particular that of Prof. Ferdinand Braun. However, as a work affording much-desired information on the practical limitations of the art from the point of view of an engineer who has been actually engaged therein, one-sided though it may be, it is extremely welcome, in contrast to the far too numerous pettifogging and misleading treatises which have flooded the market from the pens of scribblers.

As might be expected from the keenness of the rivalry which has taken place between companies and nations whilst the subject has gradually been unfolded, a great deal of highly-controversial matter is introduced, especially as regards questions of history and priority. On these matters pages might be written by way of criticism alone if the grounds of such criticism were to be fully explained. It will, however, suffice for this review if one or two of the more salient points are dealt with.

In the first place, it should, perhaps, be explained that the work bears the impress of having been translated from the German, as revealed by sundry somewhat obscure passages. This, however, is almost inevitable where an abstruse technical subject is concerned.

The author appears to be carried away by an overwhelming desire to do honour to Prof. Braun, and some of the claims made on his behalf cannot, it is thought, be substantiated. Thus he attributes entirely to Prof. Braun the principle of exciting oscillations in the antenna by the intermediary of a closed oscillating circuit. There is no doubt whatever that this principle was recognised, in this country at least, before any publication of Braun's methods had taken place. It was used in Post Office experiments at Dover in 1897 in connection both with transmitter and receiver, and was independently developed by Marconi quite early in the history of the subject. Indeed, it is to Marconi, undoubtedly, that the credit of its *proper* development must be attributed, for it was not rendered clear in Braun's first English patents, nor apparently in any other publica-

tion at that time, that the tuning of the antenna and oscillation circuit to the same period (or approximately the same period) was necessary to secure consistent and good results. It is one thing to have a glimmering that this ought to be the case, but quite another to realise its full practical significance, and Marconi certainly showed that he did realise it. We hold no brief for Marconi, but feel that, in all fairness, this ought to be plainly stated. Marconi went further, even at this early stage. He made use of the principle of weak coupling in order to secure enhanced tuning, and by its means was able first to demonstrate the possibility of diplex transmission and reception. Here again, however, to be quite fair, it is not clear that Marconi recognised weak coupling as a principle. He rather arrived at the result from rule of thumb, without apparently realising its general applicability. Max Wien was undoubtedly the first to demonstrate the general principles of coupling in his now well-known essays. There are a number of controversial points of this kind in the work before us, in which the author betrays too much anxiety for his German savants or too little knowledge of the work done in this country.

It is, however, in the practical results obtained and briefly summarised in the book that the principal interest is centred. In this connection, the question of the degree to which tuning can be practically and usefully availed of, with due regard to efficiency, has perhaps the greatest interest. It is, of course, as explained by the author, on the degree of coupling that the sharpness of tuning depends, and the sharpness that can be obtained in this way is surprising. Within a range of wave-lengths comprised between 100 and 500 metres it is theoretically possible, according to the author, separately to discriminate simultaneous messages from 322 senders without mutual interference. With a 5 per cent. dissonance 33 senders could be used, but the range of signalling is, in both cases, seriously crippled by the weakened coupling. With a 10 to 1 distance ratio and waves differing in length by 10 per cent., it appears necessary in German practice to weaken the coupling so that the maximum range of 300 miles is reduced to 125 miles in order to secure freedom from interference. The former are, of course, fancy figures in which a very great deal is sacrificed in the way of range in order to secure a sharpness of tuning which is not warranted by any circumstances which hold in practical work. But the author goes on to assure us that appreciable tuning can only be obtained at the sacrifice of range in any case. If this fairly represents present-day German practice, it is safe to say that we can do better in England. A considerable degree of tuning, and therefore of immunity from interference can, in English practice, be obtained without sacrificing *anything* in the range. The reason is possibly not far to seek, and it appears to lie mostly in the method of connections used in the German receiver, which must entail considerable damping.

The use of an earth connection is, according to the author, almost entirely discarded in German practice, a capacity being used by preference. The curious argument deduced from this is that the earth cannot play any important part in conducting the waves. It is strange that so many engineers should find it difficult to imagine that the waves can be guided by the conducting surface of the earth, in view of the fact that it can readily be shown that they are guided by wires or any other form of conductor. Why make an exception of the earth? There is certainly nothing more strange in the idea of these waves progressing over the surface of the earth than in the guiding of telephone impulses along a circuit or of telegraph signals along a submarine cable.

The form of electrolytic detector known in Germany as the Schloemilch detector comes in for a fair share of attention. Unfortunately, the author gives no indication of its relative sensitiveness. It would be extremely interesting to know the practical results obtained with this detector, as such prodigious claims have been made for it by our American friends that some verification appears desirable.

To the casual reader of this work it would appear that the acme of perfection has been arrived at in German practice, and the author indeed appears to be of opinion that only some far-reaching discovery such as the generation of continuous trains of waves can possibly improve the standard obtained.

ELECTRICAL LEGISLATION OF THE PAST SESSION.

[By our Parliamentary Correspondent.]

For the second year in succession the chief, and it may almost be said the only, scene of interest at the Houses of Parliament has been the Grand Committee Room over Westminster Hall, where the fight for supplying London with electric power has been keenly waged between the London County Council and the promoters of the Administrative County of London Electricity Supply Bill. Even here, however, the interest has not been so great as was foreshadowed at the close of last session, when the Administrative Co. came successfully through the ordeal of two committees only to find that all their energy and money were thrown away by the rising of the House. Had the late Government remained in power there is not the slightest doubt but that the promoters would have reaped their reward, but the result of the general election in January absolutely changed the condition of affairs. A Government which contained over 30 London County Councillors amongst its supporters, could not afford to do justice to a private syndicate, and the chief interest lay in seeing how far the Council's Bill, which had been condemned by its own Finance Committee as financially unsound, would be carried. It will be fresh in the minds of readers of the Electrical Review that even the present Government could not quite swallow the Bill, but the Committee recommended that the London County Council should be the authority for supplying London, and accordingly hung up the matter so that the County Council may bring forward another scheme next year. The result is that the benefit of a cheap supply of electricity to the industrial community of London is delayed for yet another year, and a few thousand pounds more of the ratepayers' money is wasted. The Administrative County of London Bill which, in the words of the Committee, "appeared to be conceived on scientific lines, and calculated to afford a cheap supply of electrical energy at private risk," is hung up, and at first sight it would appear that the promoters might just as well drop the matter. There is, however, one ray of hope for them. Next March London will be called upon to elect a new Council, and as many of the most ardent spirits of the present Progressive Party are now at Westminster, and will probably not seek re-election, and as the ratepayers have had one or two glaring illustrations of the results of municipal trading by the Council, they may for once shake off their apathy and return men to Spring Gardens who will have nothing to do with speculative schemes of such a character.

Although the London County Council and the Administrative County schemes were the only two which came before the Special Committee, when Parliament assembled there were no fewer than 12 Bills dealing with the electric supply of London. Of these the Bills promoted by the Charing Cross, West End and City Electricity Supply Co., the City of London Electric Lighting Co. the London Electric Supply Corporation, the South Metropolitan Electric Light and Power Co., and the West London Electric Undertakers' Association, were all withdrawn, arrangements having apparently been made with the Administrative Supply Bill promoters which safeguarded the interests of the supplying electrical companies of London. The Metropolitan Electric Supply Co., who sought to extend their Act for the supply in bulk to other districts in the neighbourhood of London got their Bill through nearly all the stages in the House of Lords, but owing to the House rising, it is held over till October next. Two municipal bodies got extensions of their powers, viz., St. Pancras, for the extension of their generating station, and Hackney for power to supply neighbouring municipal bodies with electricity in bulk. Stepney Borough Council, which had a Bill somewhat similar to that of the Hackney Borough Council, withdrew it. One other Bill affecting London, which, when first promoted, was looked upon as having a good chance of success was that known as the St. Neots scheme for supplying railway companies chiefly with electric power. The Bill,

however, was rejected in the House of Commons on second reading, and did not come before the Committee at all.

Eight other electric power Bills from different parts of the country were promoted, but the interest in them was practically nil. At one time, judging from the number of petitions, it looked as if there would be a stiff fight over the Lancashire Bill, for all the local authorities were up in arms over the suggested power, which would allow the company to appeal to the Board of Trade if an urban district council refused to allow them to come in and light the district. However, as the result of a conference, the local authorities retained their veto, and the company modified the objectionable clause, and accordingly the Bill went through practically unopposed. Another power Bill which looked like being well argued was that promoted by the Kent Collieries Co., but very early in the session the promoters withdrew. The Derbyshire and Nottinghamshire Electric Power Co. were allowed to take over the Newark Light Railway, and to raise half a million additional capital, while the South Wales Co. got power to raise £1,000,000 capital to carry out the obligations of the Carmarthenshire Co., which last year they were allowed to take over. The County of Durham Electric Power Co. had a number of provisions for the advancement of their interests in their Bill, which went through without opposition. The Kent Electric Power Co. also had a Bill for the transfer of powers, &c., which was carried with little trouble. Two new schemes were promoted and carried; they were the Shropshire, Worcestershire and Staffordshire Electric Power, which incorporates a company with a capital of £600,000, and the Cumberland Electricity and Power Gas Co., which will have a capital of £450,000. The Committee laid a condition on the first-named company that the powers were not to be acted upon unless half the capital was subscribed.

Few electric lighting schemes were before Parliament. The Twickenham and Teddington Co. got through their Bill which enables them to supply one parish from a generating station in another. This was necessary owing to a difficulty which arose last year in the supply of a parish in Surrey in the same way. The Folkestone and District Supply Co. had no difficulty in carrying a Bill to allow of agreements being entered into with the Sandgate Urban District Council, and the Newcastle-upon-Tyne Electric Supply Co. got through their proposals for taking over certain electric lighting orders, &c. The Ascot and District, the Brixham, and the Crediton Gas Companies obtained their Bills for supplying their districts with electric light; and the Dowlais Gas Co. got a clause to enable them to apply for an Electric Lighting Order.

Prominent amongst the Tramway Bills was that of the London County Council, who again achieved a triumph by successfully carrying their scheme for tramways over the bridges and along the Thames Embankment. In this they were assisted materially by the City Corporation, who promoted a Bill for the widening of Blackfriars Bridge and for the construction of the tramway over the bridge, which will be leased to the County Council. The London Southern Tramways Co. again came forward with proposals to electrify their lines, but the Bill was withdrawn, and the undertaking is being acquired by the County Council. Other London Tramway Bills were those of the North Metropolitan Tramway Co., which simply cleared up the affairs of the company, whose undertaking has been absorbed by the County Council; and of the London United Tramway Co., who simply asked for further powers to enable them to complete authorised lines. The Middlesex County Council were before Parliament with a Bill for the construction of tramways in the Cricklewood and Paddington districts, but here again the London County Council intervened with the result that a compromise was arrived at, and the Middlesex Bill was thrown out. An outer London scheme was that of the Empire Electric Light and Power Co. to construct tramways at Romford at a cost of £90,000, but this was withdrawn. In regard to provincial schemes, there were two Richmonds in the field for the provision of a tramway service for Folkestone, Sandgate and Hythe. One which was for the formation of a new company, was dropped, and the Bill of the Folkestone, Sandgate and Hythe Electric Co., who estimate that they will spend £93,000 on the scheme, was approved of. After several attempts to get a tramway service for Macclesfield and district, a scheme for the formation of a company with a capital of £135,000 to construct a system was carried. The Notts and Derbyshire Tramways Co. were successful with a small Bill for increasing their powers in various respects, and the Preston, Chorley and Horwich Tramway Co. got powers to sell certain of their tramways to the Wigan Corporation. The Bill of the Oldham and Saddleworth Tramway Co. to abandon the undertaking was carried, as was that of the Southport and Lytham Co. for an extension of time and works, and that of the South Lancashire Tramways Co. for authority to enable local authorities to lease lines to the company. The Bill of the West Cumberland Electric Tramways Co. was dropped, but an important new scheme, which was agreed to, was for the construction of tramways in the West Riding and Yorkshire by a company formed with a capital of £120,000.

Of tramway measures promoted by local authorities that by the Oxford Corporation looked like leading to a struggle, but it was dropped very early in the session. An important Bill was that of the Edinburgh Corporation who are seeking to electrify their system throughout, and the result of the Committee's decision was such as to greatly assist the Corporation in this direction. Bury Corporation will, as the result of their Bill, be able to extend their system at a cost of about £60,000, and the Haslingden Corporation propose under the Act they have carried, to expend about £100,000 on tramways. Huddersfield Corporation got a few additional powers for tramways under their omnibus Bill, and the Kingston-on-Hull Corporation in their Act will be allowed to spend about £75,000 on tramways. Manchester Corporation are authorised to raise £30,000 for tramway purposes, and the Wallasey Corporation about £40,000.

With respect to railway schemes, by far the most important was that of the London Outer Circle Railway, which proposed the construction of a railway to run from a junction with the South-Western Railway round the west, north, and east, to join with the London and Tilbury Railway. Powers were asked to electrify the line, but after a long hearing, Sir Geo. Doughty's Committee rejected the Bill with some amount of regret. The North-East London Railway Co. got powers to raise additional capital; the Baker Street and Waterloo Railway power to deviate the railway at Paddington; the Watford and Edgware Railway, an extension of time for the completion of work, and for the transference of the undertaking of the Edgware and Hampstead Railway to the company; and the North-West London Railway to raise £1,000,000 additional capital, &c. The Metropolitan District Railway Co. obtained various powers, including the raising of additional capital, and the Metropolitan Railway were authorised to improve Baker Street station, &c. A rather unusual course was pursued by the promoters of the Hammersmith, City and North-East London Railway, who moved Parliament to allow the Bill to be suspended till next session, and this was agreed to. Of provincial schemes the Mersey Railway Co. failed to obtain power to run motor-omnibuses, but the North and South Shields Electric Railway Co. got enlarged powers with regard to the acquisition of land. There were two competing schemes for electric railways in Cork, and the result was that the Cork Link Railways Bill was rejected, and the proposal to form a company with a capital of £150,000 to construct railways was approved.

Of what may be called miscellaneous Bills, three only were of electrical interest, and two of these died natural deaths. One was the fantastic scheme for the construction of a motor way from London to Brighton, and the other the Bill of the Metropolitan Pneumatic Dispatch Co., which, rejected last year, never got beyond the formal stages in the past session. The third Bill was the General Powers Bill of the London County Council, which contained the twice-rejected clause for allowing local authorities to provide electrical fittings, and this year the clause went through.

It will be seen that the past session has been one somewhat barren in results for those interested in the electrical industry, but the outstanding feature has been the triumph of the London County Council all along the line, for, in addition to the matters touched upon, the Council were successful in carrying several other Bills, including that for the erection of a new County Hall.

THE NEUTRAL MARKETS OF THE WORLD: THEIR OPPORTUNITIES.

VIII.—Guatemala and Costa Rica.*

(*a*) *Guatemala.*—The Republic of Guatemala, situated in Central America, covers an area of 48,290 sq. miles and has a population of about 1,750,000. Of the Central American States, other than Mexico, it is quite the most important, and at present offers the greatest advantages for the extension of trade, and the development of industrial conditions.

In 1904, the latest year for which details are available, the imports were higher than in any of the previous seven years, being valued at £1,008,228, as against £594,327 in 1903; the exports were about normal, amounting to £1,510,373, as against £1,343,797 in 1903. The United States, with 37 per cent. of the total imports, holds the greatest share of the trade, the United Kingdom following with 23 per cent., and Germany with 20 per cent.; deducting maize and flour from the total imports, it will be seen that the United Kingdom, then holds first place. At first sight this would appear to be very satisfactory, and to prove that the United Kingdom had regained her general trade in this part of the world; but on analysis of the returns, it is found that her commanding position is due almost solely to her exports of cotton goods, and some classes of woollens. The United Kingdom is also first in supplying coffee machinery, galvanised iron sheets, and tin plates, and holds her own in sacks, but in iron and steel manufactures, electrical apparatus, glassware, china and earthenware, belting, tools, &c., her share is insignificant; in electrical apparatus and machinery, the United States and Germany divide the trade, and as no British are locally interested in the various electrical companies, the United Kingdom has but a poor chance, unless represented by agents on the spot. There is only one British importing house in Guatemala, and that house deals only in cotton and woollen goods; firms importing machinery, tools, &c., are German, Belgian, French or American; a British house for these goods is not to be found. The British Consul in Guatemala recently stated that he considered the principal cause of our failure to obtain markets for our goods to be the want of established British houses to take up agencies; such persons as are agents for British firms have no showrooms, and one rarely sees an advertisement. American enterprise, on the other hand, is making considerable impression in Guatemala, but it must be allowed that conditions greatly favour United States manufactures. During recent years they have been doing effective work in the Republic, and have taken good advantage of the favourable conditions. Several commercial travellers have been sent to study the conditions and to take sample orders. It is stated that if the market is properly worked and sufficiently long credits given, practically none but American goods need be found in the Republic. The market is worth considering, for it is anticipated that the next few years will see great developments in the country. The natural resources are very great, and the tendency seems to be to take advantage of them; the opening up of the new railway to the Atlantic Coast is expected to have a wonderful effect on the country. Considerable development has been, and is being, made in the utilisation of electricity for lighting, traction and power purposes. It was recently decided to electrify the tramway lines of the city of Guatemala, and a concession has been given to the tramway company for the carrying out of the work, the necessary power to be obtained from the River Las Vacas. There should also be considerable opening for the application of electricity for mining purposes; the mineral deposits of the Republic cover a wide area, and are very rich, and with the quiet that has reigned for the last six or seven years much more interest is being taken in mining properties than has been the case for many years. Deposits of copper are said to be very plentiful. The mining laws are very liberal, and the interests of the miners are well protected. The telegraph lines of the country have recently been radically reformed, and new lines constructed to the extent of about 1,000 kilometres, for which 28 new offices have been opened. The electric lighting of the city of Guatemala is in the hands of the Empresa Electrica de Guatemala, which established its works in 1896, with four turbine-driven Siemens & Halske generators of 1,750 kw. aggregate.

The following is the Customs treatment of electrical materials, &c., in Guatemala:—Electric machinery and batteries not charged, destined to the public service, free; electrical apparatus, excepting chemical products employed in such apparatus and enumerated in the tariff, 2 cents per kilog. gross; locomotives, carriages, tools and materials for railways, 2 cents per kilog. gross; galvanic batteries and their extra parts, free; wire of iron, galvanised or of copper insulated for the transmission of electricity, free; globes, glass for incandescent electric lights, free; machinery, including steam machinery for agricultural and mining purposes and detached parts, free; materials for electric lighting, free; machines or motors, steam or wind, 2 cents per kilog. gross. The Customs regulations provide that 30 per cent. of the duties shall be payable in American gold coin. In most cases duties are levied on the gross weight, so that it is necessary that packages should be as light as possible, but at the same time it is essential that the packing should be secure, as there has recently been much complaint about goods having been stolen from boxes in transit.

The following are some of the firms in Guatemala interested in the importation of electrical goods:—

Guatemala: Empresa Electrica de Guatemala, Rodenas y Cia., J. Vassaux y Hijos, Van de Putte & Co., S. C. McNider.
Quezaltenango: H. H. Morehouse, Juan Aparicio e Hijos.
San Marcos: J. Ignacio Lopez, Sabozano, J.M.
Huehuetenango: Monzon y Cia.
Coban: W. A. Dusseldorf.
San Jose: Central and South American Telegraph Co.

The question of credit is very important, at present from four to six months is in many cases granted by European houses, whereas United States manufacturers require cash. It is stated that immediately American houses attend to the question of credits they will, owing to the popularity of their goods, secure a great part of the trade which is at present in the hands of European houses.

The British Consul at Guatemala in a recent report on the trade of the country, wrote as follows: "The outlook for the future is, on the whole, more favourable than it has been for many years. Peace has been preserved, though not without difficulty, and with increased prosperity, the number of malcontents tends to decrease. The completion of the Guatemala Railway (northern) will shorten the distance from Europe and the United States, and will promote trade. Already German and British steamers are calling at Puerto Barrios, in addition to those of the United Fruit Co. The breaking up of the monopoly hitherto enjoyed by the Panama Railroad Co., in combination with American steamship and railway companies, will also bring healthy competition into the trade *viâ* the Isthmus, and rates will be reduced all round. With continued peace, and with it the prospect of increased labour facilities, so that the agricultural and mineral wealth to be won from the soil may attain to its fullest development, there is a fair chance of brighter days dawning for Guatemala."

(*b*) *Costa Rica.*—Costa Rica, perhaps the healthiest and most beautiful of the Central American States, covers an area of 54,000 sq. kilometres, and has an estimated population of about 322,600 inhabitants. The most important town and the greatest centre of population is San Jose, which is lighted by electricity, and has a service of electric tramways. The country is very rich in natural products, but is greatly in need of foreign capital and immigration for the development of its resources. Unlike other Central and South American States, Costa Rica has been free from revolution or disturbance for nearly half a century, so that investment of capital has been, and is, attended with less risk than in the other neighbouring Republics. The trade of the country has considerably increased in recent years, so that in 1904 the imports amounted to £1,228,601, an increase of 22 per cent. as compared with the figures for 1903; the exports for 1904 showed a decrease. More than half the total import trade is now in the hands of United States merchants and manufacturers; a great part of this trade has been taken from the United Kingdom. The imports from the latter country, which in 1900 amounted to 27·3 per cent. of the total, have gradually and consistently decreased, until in 1904 they amounted to only 19·3 per cent. The import trade of Germany in the same period has decreased from 13·6 per cent. to 12·5 per cent.; the imports from France and Italy, although small, have slightly increased. The predominance of United States trade is, of course, due in part to her proximity to the market and good steamship communications, but there is no doubt that it is also due to that interest and persistency which characterises the efforts of American manufacturers in all the Latin American States. It is stated that the import trade of Costa Rica with the United States is destined to increase largely in the next few years, and particularly after the opening of the Panama Canal, which will greatly facilitate trade with this Republic. Details as to the imports of particular classes of goods into Costa Rica are not available since 1903. In that year the imports of railway material amounted to 1,584,410 fr., of which 1,026,810 fr. were from the United States; the imports of material for the electrical industry amounted to 192,530 fr., of which 183,860 fr. were from the United States; mining materials were imported to a value of 250,795 fr.; and machines to a value of 559,095 fr. The total imports of metals and manufactures thereof amounted to about £200,000. The chief exports are coffee and bananas, the latter trade being in the hands of the United Fruit Co., a large American company running its own vessels to and from Limon.

The use of electricity in Costa Rica has considerably developed in recent years. As has already been stated, San José, the chief town, is lighted by electricity, and has an electric tramway service. The other large towns of the Republic have also introduced electric light, and the telephone is in general use in the country. Other than San Jose, the chief towns are Limon and Punta Arenas, which are also the ports of the country. Coal is very scarce, but there is a considerable supply of water-power available for the production of electric energy. The Republic is rich in minerals which, owing to lack of capital, have not yet been fully exploited, the country at present being chiefly dependent on agriculture. The Government hope, however, by means of protection, to establish certain flourishing industries of an elementary character, although the dearness and scarcity of labour is a considerable obstacle to this enterprise. The country is served with railways by the Costa Rica Railway Co. and the Northern Railway Co., which have recently been amalgamated to form one American concern, a further proof that United States capitalists are determined to obtain a substantial

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* The previous articles of this series have been published as follows:—

I. Argentine Republic, Elec. Rev., March 9th, p. 411.
II. Brazil, Elec. Rev., March 23rd, p. 493.
III. Chile, Elec. Rev., March 30th, p. 531.
IV. Peru, Elec. Rev., April 13th, p. 619.
V. Paraguay and Uruguay, Elec. Rev., April 27th, p. 699.
VI. Bolivia and Colombia, Elec. Rev., June 8th, p. 939.
VII. Mexico, Elec. Rev., August 17th, p. 276.

footing in the Republic. Every encouragement is given to foreigners to immigrate and to invest capital in the country; valuable concessions are granted by the Goverment on very liberal terms, and the rights of foreigners are well protected by the State.

The following is the Customs treatment of various goods in Costa Rica:—Gas and petroleum engines, free; machines for the treatment of coffee and rice, and for the manufacture of sugar, free; machines for manufacturing textiles, free; lamp globes, shades, &c., 11 cents per kilog.; machinery of all kinds for industrial purposes, not elsewhere specified, 2 cents per kilog.; lamps, &c., 22 cents per kilog.; metal fans, 1·09 colons per kilog.; lighting apparatus, 22 cents per kilog.; tramways and accessories, free; wire, 7 cents per kilog.; wire cables, 2 cents per kilog.; rail and tramway cars, 22 cents per kilog. Duties are levied on the gross weight, so that packing should be as light as possible; at the same time it should be remembered that, as the climate is very humid, goods liable to be affected by moisture should be packed in zinc-lined cases or wrapped in waterproof sheets.

The following firms are interested in the importation and sale of electrical goods in Costa Rica:—

San Jose.—Costa Rica Electric Light and Traction Co., Ltd.; Telephone Co. of Costa Rica; Central and South American Telegraph Co.; Compagnie des Tramways de San Jose; L. Batres; Mendiola Boza; M. V. Dengo; M. Purdy; W. C. Teller.

Heredia.—Compania Luz Electrica.

Alajuela.—Compania Luz Electrica.

Naranjo.—R. C. Blanco.

Foreign houses, as a rule, grant three, six or even nine months' credit, but care should be taken to ascertain the reliability of the firm dealt with. There are several forwarding agents at Limon, notably F. J. Alvarade y Cia. Goods destined for San Jose should be addressed direct, in order to avoid delay, as custom's operations are carried on there as well as at Limon and Punta Arenas.

THE CAR-DRIVER'S LITTLE-GO.

(At least one well-known American tramway company has drawn up a list of questions for its drivers. The answers received must sometimes be of considerable interest.)

"It is wholly mispossible that an superior-second-division-with-four-stripes driver of the Bis-dopf-Mittelheim-Schnellelektrische-land-Strasseisenbahn should by one liddell Amerikanisch-twenty-watt-tramway for service rejected be! Himmel! To think there-over already costs me one dollar lager.

"When with my tesdimonials in offiee of Samsonville Tramways I am come I think myself that in small time, after they duly inspected by High-over-inspector, junior-secretary-inspector and in-red-ink-noted thereon by Over-and-assistant-Registrar, with Government stamp also ornamented are, so shall I to position of traffic-manager at least be inducted. But, how then? I come herein to a small shed whereat is one table and large cigar-smoke. Behind him sits a perspiring man of hawk aspect and disconsolate clothing. I gommence, with most politeness, 'I would the Herr-acting-Manager-of-Traffics-department to see.' He groont. With much more politeness I repeat 'My Beglaubigungschrieben are to hand all in order by me.' He antwort 'That-be-dam. Are you for motorman's position apply?' 'Ya, gewiss,' say I. 'So, then you will to me these questions immediate answer.' I am transmogrified. What informalitude! What country!"

He reads very quicks from list that therein is: "Are you born? Are you married? Wherefore? &c.," the usual-as-in-police-registration-forms preliminungs. To satisfaction I answer him all. Presently he gommence: "What does one bell from gonductor mean? What two bells? What three bells?" I say "It mean he is oxcited." "What does four bells mean?" "Perhaps he play a tune." He snort. "Should conductors' orders always be obeyed?" "Himmel!" say I, "I think nod."

"What rights have people in the street?" I am here certain, "Onless militär, none at all."

"What vehicles have the right-of-way over the car?"

"Those what more large and stiff are."

"If a cart persist to block the track, what do you do?" "Nossing."

"Would you help eject a person if called on by the conductor?"

"Yes, I help him, I gif him moral support."

"What should be reported as an accident?"

"Anything whereover damages can be claimed"

"Where should the rear platform be when car is stopped to take on or let off passengers?" I shmile. I say, "Behindt." I am not so easy flapgustered.

"What use of liquor do you make, if any?"

I say "I eat it." He is gonfused, I see by his pleated outlook.

"If the trolley leaves the wire what should you do?"

"I shpeak to the gonductor; shpeak to him hard."

"If the power leaves the wire what should you do?"

"Shmoke."

"What constitutes 'absence of the conductor' from the car?"

"When he shall his ganopy-switch knock off and to the saloon for 10 minutes go, he is absend—unless he gommunicate by piccolo."

"What is the rule as regards the use of sand?"

"Have sand always; but liddle grit is bedter." (I am shtudy the American language.)

And then afterwards he inform me I am not engaged! Potztausend-schwartz-blitzendonnerwetter, &c., &c.

THE LIMITATION OF MUNICIPAL ENTERPRISE.

An extract from the 1906 issue of the "Stock Exchange Official Intelligence" occurring in the *Times* of April 20th contained these words:—"Section 3 of the Communal Taxation Law (Prussia) provides that 'commercial undertakings of the communes shall be administered upon the principle that the income raised shall suffice at least to meet the whole of the expenditure arising from the communal undertaking, inclusive of interest and redemption of the invested capital. An exception is admissible so far as the undertaking serves at the same time a public need which is not otherwise met.' The latter part of the provision refers to waterworks, markets, and similar undertakings, but these concerns are, as a general rule, to be so managed that no loss shall fall on the local taxes."

Our experience of the "profits" arising from municipal trading in England might lead us to suppose that in Germany communal undertakings not coming under the title of "public needs not otherwise met" are relatively rare, but Mr. G. J. N. Rogers, the author of the article from which we have quoted, shows that undertakings which the private investor must regard with speculative feelings, are carried on by the communes in face of the apparent obligations of the law. "A large majority possess municipal theatres and concert halls. A few own quarries; one (Görlitz) engages in the manufacture of bricks and tiles, owns a coal mine, and manufactures artificial stone. . . . Several towns deal in timber for building purposes and the supply of fuel," and "as regards tramways . . . it is the evident intention of the communal bodies generally to obtain possession of that important means of communication whenever the opportunity offers."

The question for us is—What sort of reliance could our harassed but supine ratepayers have on similar regulating clauses if applied to the powers now exercised by our local authorities?

The Prussian regulations deal—or profess to deal—with acts after a business has been started; they strive to put out the fire when it has a good hold, while what would meet the evident perils of amateur and often irresponsible trading are regulations which restrict adventure. It is better to prevent the fire starting than to take the risk of putting it out.

Nothing can be easier than to put a good face on a project, and most things are less difficult than to make the actual business equalise the estimates. If the Prussian law applied to England we should see no abatement of the kind of pot-house courage which so many of our Councils exhibit when drunk with the power of controlling money not their own. Public baths and wash-houses, public bakeries, milk depôts, slaughter houses, cemeteries, and a score of other undertakings besides tramways, electric lighting stations, gas and water works, would be promoted under that law on the strength of rosy improbabilities, just as they are now, and, by the time sufficient experience had been gained to prove once more the improvident nature of municipal trading, the harm which the regulations strove to prevent would have been done, and could not be undone. Nothing would remain but extirpation or expropriation, both likely to be exceedingly distasteful and expensive.

Probably the English law as it stands is good enough to protect the ratepayer who thinks enough to want protection, if only there were enough force to move it, and there have been encouraging signs of late that the L.G.B. is awakening to a fuller consciousness of the national trust which undoubtedly is vested in it.

Unfortunately, as we have said above in other words, when once an authority is mired, it is difficult to prevent it from sinking deeper and deeper, and all efforts to pull it out by the way it came, or by going through the whole bog, require greater strength as time passes, and may get beyond human force altogether. None has yet sunk quite, but when that happens, as it quite conceivably may, the end can be hardly heroic.

Aptly enough to illustrate these sombre remarks, there came a tale from one of our great corporations. The Electricity Committee of Leeds awoke suddenly to the knowledge that the fire of failure had ravaged the lower storeys of its establishment, and threatened to bring down the whole house.

The "Engineering Supplement" of the *Times* for April 21st said "credit is due to the management . . . . . for the courageous manner in which a difficult situation is being faced." The capital is nearly a million pounds, the annual turnover not 10 per cent., the cost per kilowatt installed £85, and there is no depreciation fund, although, after no more than 14 years' service, much of the existing plant is so obsolete as to require an immediate outlay of £125,000 to bring it up to date.

What would be the position of a private company which applied for further capital when in the year 1905-6 the *gross* profit was 7·4 per cent. of the total capital outlay, and the net profit, after providing for interest on the capital, and for sinking fund payments, was only £3,245? And do not these two significant facts, taken together, prove well enough the case for depreciation?—first, the

capital redemption at the rate of, say, 3 per cent. per annum, or a capital life of 33-35 years, and secondly, the obsolescence of a large part of the machinery, which is the only exchange for a proportionate amount of that capital, within 14 years. Obsolescent plant carries no goodwill.

Well, then, there is a concrete example pat to our hands. Leeds borrowed money in the first place to buy out the Lighting Co., fully supposing, and sincerely intending, that "the income earned should suffice at least to meet the whole of the expenditure"; and who was to say it nay? The ratepayers! They, the actual financiers or guarantors of the scheme, probably knew as much about the ultimate prospects of success as they usually know, and thought of them not at all. In 1898 the purchase was effected, and in 1906 the Chairman of the Committee says that the practice of allocating profit in relief of rates has been followed without due consideration of the rate of progress in electrical development and of the large reserves which are required to provide for early renewals. "He suggests, therefore, that the profits *wrongfully distributed* in the past ought to be returned by the ratepayers!"

That sentence is eloquent beyond measure, and we leave the ratepayers of England for the moment chewing the bitter cud of reflection, for while it is Leeds to-day, it will be somewhere else to-morrow.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

18,591. "Improvements in wire insulators." G. A. NITZSCHE. August 20th.

18,592. "Improvements in means for placing wires into the angular grooves of wire insulators." G. A. NITZSCHE. August 20th.

18,599. "Improvements in processes for the production of voltaic strong-current arcs." H. PAULING. August 20th. (Complete.)

18,600. "Improvements in electrodes." H. PAULING. August 20th. (Complete.)

18,607. "Improvements relating to holders for cards, being attached to electricity, gas and water meters and the like." N. A. CHESTERFIELD. August 20th.

18,608. "Improvements in condensers for electrical purposes." J. A. ROMER. August 20th.

18,610. "Improved electric current interrupter." SOCIETE ANONYME DES ANCIENS ETABLISSEMENTS PANHARD ET LEVASSOR. (Date applied for under Patents Act, 1901, November 18th, 1905, being date of application in France.) August 20th. (Complete.

18,621. "Improvements in dynamo-electric machines and the like." L. TORDA. August 20th.

18,622. "Improved method of producing metallic incandescence bodies for electric glow lamps." P. M. JUSTICE. (Deutsche Gasgluhlicht Aktienges. (Auerges), Germany). August 20th. (Complete.)

18,624. "Improvements in the method of and apparatus for producing electricity by steam." H. E. FRY. August 20th.

18,628. "Improvements in or relating to electric driving attachments for adding machines." A. J. BOULT. (Burroughs Adding Machine Co., United States.) August 20th.

18,641. "Improved contact head for electric apparatus." D. CRONSIOE. August 20th. (Complete.)

18,643. "Method of producing indestructible filament for lighting and heating installations." G. MICHAUD and E. DELASSON. (Date applied for under Patents Act. 1901, September 30th, 1905, being date of application in France.) August 20th. (Complete.)

18,659. "Improvements in insulated bushings for electric circuit wires." E. C. R. MARKS. (Federal Electric Co., United States.) August 20th. (Complete.)

18,666. "Improvements in prepayment attachments for electricity meters." E. PEACOCK. August 20th.

18,675. "Combined electrical and mechanical automatic sight, and control gear for guns." R. D. TIMMINS. August 21st.

18,687. "Improved splicing ear for electric trolley wires and the like." B. CROFT. August 21st.

18,693. "Improvements in detectors of electric oscillations." E. VON LEPEL. August 21st. (Complete.)

18,704. "Improvements in and relating to ignition sparking plugs." A. HOSCH. August 21st.

18,716. "Improvements in central battery telephone systems, telephonic apparatus of telephone stations having branch stations connected thereto." SIEMENS BROS. & Co., LTD. (Siemens & Halske Aktien Ges, Germany.) August 21st. (Complete.)

18,724. "New or improved system or method of laying or erecting and improvements in or relating to conduits or casings for electric conductors." F. W. V. PARK. August 21st. (Complete.)

18,729. "Improvements in electric furnaces." C. O. WINGREN. (Date applied for under Patents Act, 1901, August 21st, 1905, being date of application in United States.) August 21st. (Complete.)

18,738. "Improvements in the manufacture of filament of metallic tungsten or molybdenum for electric incandescent lamps." A. LEDERER. August 21st.

18,739. "Improvements in electric motors." D. MENDELSON. August 21st. (Complete.)

18,745. "Improvements in methods of manufacturing filaments." THE BRITISH THOMSON-HOUSTON Co., LTD. (The General Electric Co., United States.) August 21st.

18,746. "Improvements in and in the manufacture of boron and boron compounds and in the production of electric incandescing bodies therefrom." THE BRITISH THOMSON-HOUSTON Co., LTD. (The General Electric Co., United States.) August 21st.

18,747. "Improvements in methods of manufacturing filaments." THE BRITISH THOMSON-HOUSTON Co., LTD. (The General Electric Co., United States.) August 21st.

18,748. "Improvements in and relating to filaments." THE BRITISH THOMSON-HOUSTON Co., LTD. (The General Electric Co., United States.) August 21st.

18,749. "Improvements in and relating to filaments." THE BRITISH THOMSON-HOUSTON Co., LTD. (The General Electric Co., United States.) August 21st.

18,750. "Improvements in and in the manufacture of electric conductors more especially applicable for use as incandescing bodies in electric lamps." THE BRITISH THOMSON-HOUSTON Co., LTD. (The General Electric Co., United States.) August 21st.

18,751. "Improvements in and in the manufacture of electric conductors more especially applicable for use as incandescing bodies in electric lamps." THE BRITISH THOMSON-HOUSTON Co., LTD. (The General Electric Co., United States.) August 21st.

18,752. "Improvements in and in the manufacture of electric conductors more especially applicable for use as incandescing bodies in electric lamps." THE BRITISH THOMSON-HOUSTON Co., LTD. (The General Electric Co., United States.) August 21st.

18,762. "Improvements in and relating to electric alarm clock." E. N. DAVEY. August 22nd.

18,811. "Improvements in the manufacture of incandescent bodies of metallic tungsten or molybdenum for electric incandescent lamps." A. LEDERER. August 22nd.

18,812. "Improvements in supports for metallic filaments for electric incandescent lamps." A. LEDERER. August 22nd.

18,816. "Improvements in and relating to electro-magnetic coupling devices." The Hon. C. A. PARSONS, G. G. STONEY and A. H. LAW. August 22nd.

18,817. "Improvements in and relating to dynamo-electric machinery." A. SCHERBIUS. August 22nd. (Complete.)

18,829. "Improvements in the operation of electric clocks by means of electrical waves." M. REITHOFFER and F. MORAWETZ. August 22nd. (Complete.)

18 835. "Improved method of and means or apparatus for heating molten or semi-molten materials by electricity." F. WYNNE. August 22nd. (Complete.)

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18,874. "Improvements relating to electric incandescent lamps." A. LEDERER. August 23rd.

18,875. "Improvements relating to electric incandescent lamps." A. LEDERER. August 23rd.

18,877. "Improvements in and relating to systems of electric motor control." THE BRITISH THOMSON-HOUSTON Co., LTD. (The General Electric Co., United States.) August 23rd.

18,886. "Improvements in electrodes for secondary batteries." H. F. JOEL. August 23rd.

18,889. "Switches for telephones." K. WEMAN. August 23rd. (Complete.)

18,905. "Improved construction of switch for automatic electric lifts or elevators." J. RICHMOND & Co., LTD., A. C. BURNETT and F. K. LYON. August 23rd.

18,944. "Improvements in compound telephones." C. G. F. HOLMGREN and A. E. BRAHM. Date applied for under Patents Act, 1901, March 9th, 1906, being date of application in Sweden.) August 24th. (Complete.)

18,956. "Improvements in and relating to alternating electric current motors and in systems of operating and controlling same." THE BRITISH THOMSON-HOUSTON Co., LTD. (General Electric Co., United States.) August 24th.

18,957. "Improvements in and relating to electric motor control apparatus." G. W. EUKER. (Date applied for under Patents Act, 1901, August 31st, 1905, being date of application in United States.) August 24th. (Complete.)

18,965. "Improvements in telephonic apparatus." E. A. GRAHAM. August 24th.

18,982. "Disease-preventing safety cap for telephone receivers." H. A. SNELLING. August 25th.

18,996. "New or improved prepayment device for use in combination with an electric meter." H. LEE. August 25th.

19,002. "Improvements in and in connection with the covers of electric cells." A. E. SEGNITZ and W. E. PARKES. August 25th.

19,005. "Improvements in oil-break electric switches." A. ECKSTEIN, A. C. HEAP and D. B. MELLIS. August 25th.

19,037. "Improvements in or relating to electric ignition for explosion engines." A. J. BOULT. (Luis de Loma, France,) August 25th.

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1905.

ELECTRICAL CABLES. H. E. Edmunds and P. Dawson. 12,170. June 10th.

MEANS FOR THE PRODUCTION OF LONG STABLE ELECTRIC ARCS. J. T. Johnson (Badische Anilin & Soda Fabrik.) 14,955. July 20th.

STARTING AND CONTROLLING DEVICES FOR ELECTRIC MOTORS AND THE LIKE. H. Kallmann. 16,292. August 10th.

SINGLE-PHASE ALTERNATING CURRENT MOTORS WITH COMMUTATING POLES. E. Arnold and J. L. La Cour. 21,034. (Date applied for under International Convention, October 19th, 1904.) October 17th.

ELECTRIC RESISTANCES. The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) 21,753. October 25th.

TELEPHONES. H. Oppenheimer. (Akt. Ges. Mix and Genest.) 22,061. October 30th.

ELECTRIC SWITCHES. The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) 22,856. November 7th.

1906.

MEANS FOR RENDERING CERTAIN SUBSTANCES NON-CONDUCTIVE OF ELECTRICITY, WATERPROOF, AND ACID PROOF. H. D. Haigh, P. Wheeler and W. Appleyard. 1,804. January 24th.

SAFETY APPARATUS FOR OVERHEAD ELECTRIC CONDUCTORS. M. Letroteur. (Date applied for under International Convention, February 10th, 1905.) 2,548. February 1st.

ELECTRIC RESISTANCES. Physikalisch-Technisches, Laboratorium Ges. (Date applied for under International Convention, February 2nd, 1905.) 2,641. February 2nd.

DASHPOT OR CHECKING DEVICE FOR ELECTRIC MEASURING APPARATUS. E. Fauvin, E. Amiot and E. Cheneaux. 4,076. February 19th.

DYNAMO-ELECTRIC MACHINES FOR ROTATION AT HIGH SPEEDS. E. M. Tingley. (Date applied for under International Convention, April 10th, 1905.) 7,889. April 2nd.

DYNAMO ELECTRICAL MACHINES. Elektrizitats Akt. Ges., vorm W. Lahmeyer and Co. 8,786. (Date applied for under International Convention, April 28th, 1905.) April 11th.

MEANS FOR REDUCING THE REFLEX ACTION AT THE POINTS OF CONNECTION OF ELECTRICAL CONDUCTORS OR CIRCUITS DIFFERING IN THE VALUES OF THEIR ELECTRICAL PROPERTIES. Siemens Bros. & Co. (Siemens & Halske Akt. Ges.) 9,273. April 19th.